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(71) Applicant *(for all designated States except US)*: **GETSIL-ICON, INC.** [US/US]; 2975 Bower Avenue, Santa Clara, CA 95051 (US).

(72) Inventors: **LOU, Ping, Yang**; 16076 Greenwood Road, Monte Sereno, CA 95030 (US). **MINGTANG, Thomas, Yin**; 13527 Toni Ann Place, Saratoga, CA 95070 (US). **LAW, Edwin**; 20867 Canyon View Drive, Saratoga, CA 95070 (US). **SIQING, Wei**; 46725 Crawford Street, Fremont, CA 94539 (US). **JOHNSON, C., Lee**; 13193 Via Arriba Drive, Saratoga, CA 95070 (US).

(74) Agent: **LOVEJOY, David, E.**; 102 Reed Ranch Road, Tiburon, CA 94920-2025 (US).

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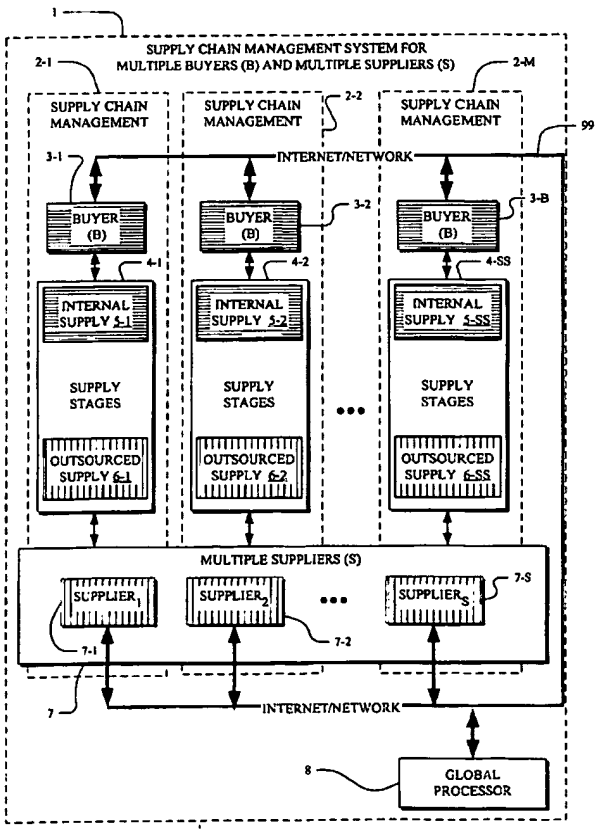
(54) Title: BUYER, MULTI-SUPPLIER, MULTI-STAGE SUPPLY CHAIN MANAGEMENT SYSTEM WITH LOT TRACKING



(57) Abstract: A global supply chain management system in an environment of multiple suppliers forming supply chains for one or more buyers connected over the Internet. The system includes a global processor with logic that maps "local" supply information for each buyer and each supplier, represented in one or more property tables having master information correlated to local information for each buyer and each supplier. The system manages processes from an input of lots to an output through supplier stages where clients each use fragmented different local information. A correlation means uses base lot indicators, one for each of the lots in common for all of said stages and executes supply chain management functions for tracking lots through the supplier stages.

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BUYER, MULTI-SUPPLIER, MULTI-STAGE SUPPLY CHAIN MANAGEMENT SYSTEM WITH LOT TRACKING

BACKGROUND OF THE INVENTION

The present invention relates to internet commerce and particularly to methods and apparatus that enable efficient management of procurement transactions between buyers and suppliers in a supply chain that includes outsourcing with multiple suppliers.

Today, buyers and suppliers operate in a fast changing global environment where quantities needed, pricing, technical specifications and other supply parameters are frequently changing. The supply chain for procurement of goods and services requires economies of scale, market pricing and rapid delivery. The management of the process of procuring goods and services is known as "supply chain management".

Supply chain management is affected, for example, by the globalization of businesses, the proliferation of product and service variety, the increasing complexity of supply networks, and the shortening of product life cycles. Market conditions are susceptible to rapid demand fluctuation, inventory buildup, price competition, and frequent specification changes. The supply chain for any particular company may be primarily internal supply. However, outsourcing is often used as an alternative to internal supply. By way of example, outsourcing is used to reduce costs, control inventories and respond to rapid demand changes. Outsourcing increasingly is involving more and more suppliers and supply chains are growing more complex.

In fast changing markets, buyers require "current" and at times "real-time" quotes and other information from suppliers that specify, among other things, accurate quantities, prices and delivery times. The ability to rapidly exchange

information among buyers and suppliers is paramount to efficient supply chain management, particularly in an outsourcing environment.

The Internet is an efficient electronic link among buyers and suppliers for exchange of supply chain information. The Internet operates with open standards and permits easy, universal and secure information exchange. Many roles exist for the Internet in commerce and some of these roles have been described as "e-business", "e-commerce", and "internet commerce". For purposes of the present specification, the term "internet commerce" (or "i-commerce") is used to represent the role of the Internet in supply chain management.

"Internet commerce" enables companies, among other things, to realize greater efficiency, have better asset utilization, have faster times to market, reduce order fulfillment times, enhance customer services and penetrate new markets. The Internet provides an enormous capability for distribution of "current" information that is useful and necessary for improved supply chain management. "Current" information often must be information available on a "real-time" or near "real time" basis. The Internet makes it possible to communicate "current" information about technology changes, availability of goods and services, up-to-date prices for goods and services and other information needed to manage a supply chain. When outsourcing is employed in the supply chain, the visibility into the current status of the supply chain is more difficult and requires new and improved methods for insuring that complete, accurate and timely information is available. In the absence of such current information, the ability to react in a timely way to exceptions, abnormal events and other matters may be lost or delayed. When the time for taking action is not recognized or is delayed, supply chain management suffers and ultimately the cost of goods and services increases.

Although internet commerce simplifies many aspects of procurement, difficulties still exist and improvements are needed. One difficulty results because large numbers of suppliers and buyers are attached to the market place and each participant, whether buyer or supplier, tends to use different parameters,

terminology, terms, conditions and other information unique to the particular participant. These differences among participants result in an information exchange problem.

The information exchange problem is particularly acute, for example, in the outsourcing semiconductor manufacturing industry because goods and services procured from one supplier are frequently further processed by other suppliers in subsequent downstream stages. In order to have efficient and economical supply chain management, the interrelationship among each buyer and the upstream and down stream suppliers requires an exchange of "current" information that permits real-time visibility into the status of the supply chain, fast identification of abnormal events and other information that permits exception management.

One difficulty that frustrates the good visibility necessary for supply chain management is the proliferation of different terminology and specifications used by each participant in the supply chain. While any dominating buyer (and potentially any dominating supplier) can demand conformance with its way of doing business for its own business, the semiconductor manufacturing industry as a whole remains widely fragmented without much progress toward standardization. Furthermore, this fragmentation is increasing rather than decreasing so that problems are bound to exist for many years to come. The fragmentation exists, of course, in many other industries.

Cooperative attempts have been made toward standardization in some industries. In the electronics component industry, the RosettaNet has the intent of providing industry wide standardization across the electronic components trading network. Some attempts have been made to standardize the semiconductor manufacturing industry. Notwithstanding these attempts, the semiconductor manufacturing industry remains fragmented and neither the RosettaNet nor any other standard has become widely adopted.

Accordingly, there is a great demand for improved supply chain management methods and apparatus that will operate efficiently in fragmented markets.

SUMMARY

The present invention is a global supply chain management system in an environment of multiple suppliers forming supply chains for one or more buyers connected over the Internet. The system includes a global processor with logic that maps "local" supply information for each buyer and each supplier, represented in one or more property tables having master information correlated to local information for each buyer and each supplier. The system manages processes from an input of lots to an output through supplier stages where clients each use fragmented different local information. A correlation means uses base lot indicators, one for each of the lots, in common for all of said stages and executes supply chain management functions for tracking lots through the supplier stages. This environment is fragmented, that is, the industry as a whole has not adopted any common set of standard terminology. In a fragmented industry, each instance of local supply information for any client (buyer or supplier) can be and usually is different from the local supply information for any other client (buyer or supplier). The embodiments of the present invention map supply information from and to the master internal property information to and from fragmented output local information according to the local property correlation for each buyer and each supplier. Notwithstanding the fragmentation among buyers and suppliers, the global supply chain management system functions to implement global supply chain management using "current" supply chain information supplied over the Internet using the fragmented local supply information used by the buyer or supplier.

To insure that the supply information is accurate, the global processor executes data integrity processes to improve the reliability of the supply

information. The data integrity processes include data checking and data cleansing so that mapped supply information through error detection and correction becomes more accurate than the original fragmented raw data. Data integrity processes are performed, for example, for data consistency within a record, data consistency within a report, data consistency across different reports from a particular supplier, data consistency between suppliers' and buyers' data and data consistency among suppliers.

Based upon a continuously updated data base having "current" supply information, the global processor provides reports for numerous data types including work-in-progress (WIP) reports, activity-based transaction reports (TR) that are created on a daily or other basis (including detail for each buyer and supplier stage), order reports, shipment reports and invoice reports. The terminology for the various reports and the items reported upon have no standard definitions. For example, *Orders* are known by different names including purchase orders (PO) that logically are for *goods* and work orders (WO) that logically are for *services*. However, common practice in many industries uses the term *Purchase Order* generically for any type of order whether for *goods* or *services*. These reports are all conveniently distributed over the Internet in a format and with the terminology selected by each client, whether the client is a buyer or a supplier.

With access to "current" supply information for multiple suppliers and with mapping capability among fragmented local property tables of multiple suppliers and buyers, the global processor enables the Internet placement of purchase orders and work orders (POs and WOs) that can be accompanied by detailed specifications using electronic attachments.

With access to "current" supply information for multiple suppliers and with mapping capability among fragmented local property tables of multiple suppliers and buyers, the global processor enables global planning from input to output of the supply chain. In the semiconductor manufacturing supply chain, the planning

extends from Wafer (front end, upstream) planning to package/test (back end, down stream) planning.

The supply chain management system is able to provide lot tracking reports, actual cost lot detail reports, wafer rolling output reports, finished goods rolling output reports, work in progress inventory reports and other reports useful for supply chain management.

The supply chain management system employs planning based upon upstream visibility in the supply chain. Such capabilities are particularly useful in outsourcing to suppliers in a semiconductor supply chain. In the semiconductor IC-design outsourcing industry, the buyer (IC-design house) deals with multiple suppliers that provide various outsourcing functions at different supplier stages. The buyer places a separate order (Purchase Order) with each supplier. Although the Purchase Orders are separate between a buyer and each supplier, each supplier depends on the previous supplier (upstream supplier) in the supply chain.

In the semiconductor manufacturing industry in order to procure finished goods (for example a finished semicondcutor chip), a buyer first orders wafers from a Fab supplier (foundry); once the work at the Fab supplier is finished, the buyer orders sorting from a Wafer Sort supplier; after the Wafer Sort work is finished, the buyer orders Assembly from an Assembly supplier; and finally, the buyer orders Final Test from a Final Test supplier. The supply chain management system is able to perform group order generation for groups of dependent suppliers (such as Fab, Wafer Sort, Assembly and Final Test suppliers) in the supply chain.

The supply chain management system performs *alert* processes based upon alert conditions for specific events/reports/process of the supply chain. Alert reports are accessible to clients through i-commerce onscreen operations or through other methods of communication. Typically, alert conditions are communicated daily (or more frequently if desired) in the form of event generation and alert messages.

The input to the supply chain can take many forms and is a function of the particular industry. The input can be raw materials, groups of components or "lots" of any kind. In the semiconductor manufacturing industry, frequently "lots" are "wafer lots" or "die lots".

Lot Tracking is implemented by logic in the global processor to store detailed information related to a lot in the supply chain. The lot tracking information is categorized into two major parts, namely, static data where the data are fixed during the manufacturing processes and dynamic data where the data can be changed during the manufacturing processes. For example, the static data includes Date Code, Lot No, Order Date, Order Qty, Part No, Production Order No, PO No, Routing, Sup, and Unit Price. For example, the dynamic data includes two main parts, namely, Date Information, {Completed Date, Hold Date, Received Date, Ship Date, Start Date} and Quantity Information (Completed Qty, Downgrade Qty, Goodpart Qty, Hold Qty, Received Qty, Returned Qty, Scrappart Qty, Ship Qty, Start Qty}.

Lot tracking stores the genealogy of a lot in order to track and recall the lot history quickly. This tracking is done by storing the parent-child relationship for lots. For flexible in loading the lot tracking data, work-in-progress (WIP) reports and activity-based transaction reports (TR) are used.

Lot tracking is unique in the sense that a robust and consistent data set for the production and finance related information of a fragmented supply chain is maintained in one central place. The maintenance of such information permits performance checking, such as cycle time, yield analysis and cost reporting on a lot basis down to each stage of the supply chain.

The foregoing and other objects, features and advantages of the invention will be apparent from the following detailed description in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGSFIG. 1 depicts a plurality of supply chain management systems organized in part on an individual buyer basis and in an environment of multiple buyers and multiple suppliers forming a supply chain and depicts a global supply chain management system for the multiple buyers and multiple suppliers.

FIG. 2 depicts further details of the global supply chain management system of FIG. 1 with a multi-stage, multi-lot processor for multiple buyers and multiple suppliers.

FIG. 3 depicts details of the supply chain management system of FIG. 1 and FIG. 2 with details for typical stages for processing.

FIG. 4 depicts details of a single one of the buyers and multiple suppliers for the multistage, multi-lot processing within the supply chain management system of FIG. 1 and FIG. 2.

FIG. 5 depicts one example of a purchase order set for a lot in the FIG. 4 system.

FIG. 6 depicts another example of a purchase order set for a lot in the FIG. 4 system.

FIG. 7 depicts another example of a purchase order set for a lot in the FIG. 4 system.

FIG. 8 depicts details of a multiple ones of the buyers and multiple suppliers for the multistage, multi-lot processing within the supply chain management system of FIG. 1.

FIG. 9 depicts a hardware block diagram of a computer system network for the supply chain management system of FIG. 1.

FIG. 10 depicts a software block diagram for the supply chain management system of FIG. 1.

FIG. 11 depicts a correlation processor for correlating input and output information among clients including mapping and data integrity processing in the FIG. 9 and FIG. 10 systems for supply chain management.

FIG. 12 depicts one example all of a multiple supplier branch in a supply chain transaction.

FIG. 13 depicts a cross supplier error checking in the example of FIG. 12.

FIG. 14 depicts one example of a lot tracking report.

FIG. 15 depicts a cross supplier lot tracking example 1.

FIG. 16 depicts a cross supplier lot tracking example 2.

FIG. 17 depicts an actual cost - lot detail report.

FIG. 18 depicts the purchase order logic flow for creation and acceptance of blanket purchase orders and purchase orders.

FIG. 19 depicts an example of Final Test purchase order.

FIG. 20 depicts an example of an attachment that appears as a thumbnail image in the Final Test purchase order of FIG. 19.

FIG. 21 depicts an example of a wafer rolling output report.

FIG. 22 depicts an example of a finished goods rolling output report with package planning.

FIG. 23 depicts an example of a work in progress inventory report.

DETAILED DESCRIPTION

FIG. 1 depicts a plurality of supply chain management systems 2-1, 2-2, ..., 2-M organized on an individual buyer (B) basis for the buyers 3-1, 3-2, ..., 3-B in an environment also including multiple suppliers 7-1, 7-2, ..., 7-S. FIG. 1 also depicts a supply chain management system 1 serving all the multiple buyers 3-1, 3-2, ..., 3-B and multiple suppliers 7-1, 7-2, ..., 7-S. The multiple buyers and multiple suppliers of FIG. 1 are connected over the internet and hence are able to exchange supply information rapidly and essentially in real time.

In FIG. 1, the local supply chain for each buyer includes supply stages 4 that typically include internal supply 5, that is, supply from the buyer's own organization, and outsourced supply 6, that is, supply from external suppliers 7-1, 7-2, ..., 7-S. Specifically, the buyers 3-1, 3-2, ..., 3-B have the supply stages 4-1, 4-

2, ..., 4-B, each in turn having the internal supply 5-1, 5-2, ..., 5-SS and the external supply 6-1, 6-2, ..., 6-SS, respectively.

Each of the local supply chain management systems 2-1, 2-2, ..., 2-M are maintained, for example, by the individual buyers 3-1, 3-2, ..., 3-B and they are typically characterized as having their own terminology, specifications and other supply chain parameters. In FIG. 1, the suppliers and buyers as a whole are widely fragmented without much standardization. FIG. 1, therefore, as it encompasses local supply chain management systems 2-1, 2-2, ..., 2-M is representative of the semiconductor manufacturing industry.

Additionally, in FIG. 1, a global supply chain management system 1 is designed to overcome the local fragmentation and efficiently serve all the multiple buyers 3-1, 3-2, ..., 3-B and multiple suppliers 7-1, 7-2, ..., 7-S . The supply chain management system 1 includes a a global processor 8 that uses network communications such as the Internet for overcoming the fragmentation of local supply chain management systems 2-1, 2-2, ..., 2-M and for providing integrated supply chain management. FIG. 2 depicts a supply chain management system operating in an environment of one or more buyers, B, including buyers B_0, B_1, ..., B_B multiple suppliers, S, including suppliers S_0, S_1, ..., S_S in a supply chain. The buyers and suppliers are connected to a Multi-stage, Multi-Lot Processor for Multiple Buyers (B) and Multiple Suppliers (S) where the supply chain includes inputs I_0, I_1, ..., I_i, ..., I_I to the supply chain and outputs O_0, O_1, ..., O_o, ..., O_O from the supply chain. The inputs are introduced to and the outputs are derived from Multiple Processing Stages (P) with Multiple Transactions (T) per Stage. The stages include $[P_{0,0}, P_{0,1}, ..., P_{0,N}]$; $[P_{1,0}, ...]$;[..., $P_{m,n}$, ...]; $[P_{M,0}, ..., P_{M,N}]$. Each stage such as a typical stage $P_{m,n}$ includes up to T transactions such as T_0, T_1, ..., T_t, ..., T_T.

FIG. 3 depicts details of the supply chain management system of FIG. 2 and details typical stages for processing. The one or more buyers, B, including B_0, B_1, ..., B_b, ..., B_B, and the multiple suppliers, S, including S_0, S_1, ..., S_s, ..., S_S are in

the supply chain. Stages $P_{m,n}$ and $P_{m,n+1}$ are typical of the many stages [$P_{0,0}$, $P_{0,1}$, ..., $P_{0,N}$]; [$P_{1,0}$, ...];[..., $P_{m,n}$, ...]; [$P_{M,0}$, ..., $P_{M,N}$] of FIG. 2. In particular, stage $P_{m,n}$ includes up to T transactions such as T_0, T_1, ..., T_T. By way of example, stage $P_{m,n}$ includes transactions (T_0), (T_1), (T_2), (T_3), (T_4), (T_5), ..., (T_T) which are, for example, ORDER, WIP, YIELD, SHIPMENT, RECEIVE, WAREHOUSE, ..., PAYMENT. Many other transactions are possible, of course.

In FIG. 3, the stage $P_{m,n}$ is in the supply chain with B_b as the buyer and S_s as the supplier. By way of another example, the stage $P_{m,n+1}$ is also in the supply chain with B_b as the buyer and S_s as the supplier. The stage $P_{m,n+1}$ may include the transactions (T_0), (T_1), (T_2), (T_3), (T_4), (T_5), ..., (T_T) which are for $P_{m,n}$ ORDER, WIP, YIELD, SHIPMENT, RECEIVE, WAREHOUSE or stage $P_{m,n+1}$ may have a different set of transactions.

FIG. 4 depicts details of a single one of the buyers and multiple suppliers for the multistage, multi-lot processing within the supply chain management system of FIG. 2. FIG. 4 depicts a supply chain management system operating in an environment of one buyer, B_b and multiple suppliers, S, including S_0, S_1, S_2, S_3, S_4, S_5, ..., S_S in a supply chain. The buyers and suppliers are connected to a Multi-stage, Multi-Lot Processor for Multiple Buyers (B) and Multiple Suppliers (S) where the supply chain includes inputs I_0, I_1, I_2, ..., I_I to the supply chain and outputs O_0, O_1, O_2, ..., O_O from the supply chain. The inputs are introduced to and the outputs are derived from Multiple Processing Stages (P) with Multiple Transactions (T) per Stage. The stages include [$P_{0,0}$, $P_{0,1}$, $P_{0,2}$, $P_{0,3}$];[$P_{1,0}$, $P_{1,1}$, $P_{1,2}$, $P_{1,3}$]; ...; [$P_{x,0}$, $P_{x,1}$, $P_{x,2}$, $P_{x,3}$]; ...; [$P_{M,0}$, ..., $P_{M,3}$]. Each of those stages includes a set of up to T transactions such as T_0, T_1, ..., T_t, ..., T_T like those described in connection wit FIG. 2.

In FIG. 4, buyer, B_b initiates operation of the supply chain in connection with a purchase by authorizing inputs I_1 and I_2. The I_1 input, such as a semiconductor lot (wafer lot or die lot), to the supply chain progresses through a first sequence of stages [$P_{0,0}$, $P_{x,1}$, $P_{1,2}$, $P_{1,3}$] to the output O_1. The supplier for the

stage $P_{0,0}$ stage is S_0, the supplier for the stage $P_{x,1}$ stage is S_2, the supplier for the stage $P_{1,2}$ stage is S_3 and the supplier for the stages $P_{1,3}$ stage is S_5. Similarly, the I_2 input, such as a semiconductor lot, to the supply chain progresses through a second sequence of stages [$P_{0,0}$, $P_{0,1}$, $P_{x,2}$, $P_{x,3}$] to the output O_2. The supplier for the stage $P_{0,0}$ stage is S_0, the supplier for the stage $P_{0,1}$ stage is S_1, the supplier for the stage $P_{x,2}$ stage is S_4 and the supplier for the stages $P_{x,3}$ stage is S_S. FIG. 4 depicts details of a single one of the buyers and multiple suppliers for the multistage, multi-lot processing within the supply chain management system of FIG. 1.

FIG. 5 depicts one example of a purchase order set for multistage processing in the FIG. 4 system. In FIG. 5, buyer, B_b, initiates operation of the supply chain in connection with a purchase by authorizing input I_1. The input I_1 to the supply chain progresses through a sequence of stages [$P_{0,0}$, $P_{x,1}$, $P_{1,2}$, $P_{1,3}$] to provide the output O_1. The supplier for the stage $P_{0,0}$ stage is S_0, the supplier for the stage $P_{x,1}$ stage is S_2, the supplier for the stage $P_{1,2}$ stage is S_3 and the supplier for the stages $P_{1,3}$ stage is S_5. In order for the work to be performed through the stages [$P_{0,0}$, $P_{x,1}$, $P_{1,2}$, $P_{1,3}$] of FIG. 5, orders authorizing and specifying the terms and conditions associated with the work are agreed upon by the buyer, B_b, and the suppliers S_0, S_2, S_3, and S_5. The orders in FIG. 5are designated $P_{0,0}S_0$, $P_{x,1}S_2$, $P_{1,2}S_3$ and $P_{1,3}S_5$. These orders are called "purchase orders" or "work orders" and apply to goods and services. In some industries, both goods and services are involved but in other industries either goods or services alone are involved.

In a semiconductor manufacturing environment, both goods and services are involved. Typically, the I_1 input is a lot (wafer lot or die lot) and the processing stages are typically Fab, Wafer Sort, Assembly and Final Test. Other stages are of course possible and include, for example, Packaging (such as tape and real), Bumping and Marking. The processing stages Fab, Wafer Sort, Assembly and Final Test are each performed by a supplier and typically the different suppliers S_0, S_2, S_3, and S_5. The work at each of the processing stages of Fab, Wafer Sort, Assembly and Final Test is authorized and controlled by the purchase orders $P_{0,0}S_0$, $P_{x,1}S_2$,

$P_{1,2}S_3$ and $P_{1,3}S_5$, respectively. The output from the stages [$P_{0,0}$, $P_{x,1}$, $P_{1,2}$, $P_{1,3}$] are represented by [$G_{0,0}$, $G_{x,1}$, $G_{1,2}$, O_1], respectively. In FIG. 5, the set of purchase orders [$P_{0,0}S_0$, $P_{x,1}S_2$, $P_{1,2}S_3$, $P_{1,3}S_5$] relate to interdependent work steps. The output, O_1, is only obtained when all of the orders [$P_{0,0}S_0$, $P_{x,1}S_2$, $P_{1,2}S_3$, $P_{1,3}S_5$] have been executed according to their terms and in sequence from the most upstream order $P_{0,0}S_0$ in turn through the orders $P_{x,1}S_2$, $P_{1,2}S_3$ to the most downstream order $P_{1,3}S_5$. Furthermore, the downstream orders depend upon the performance of the upstream orders. Typically, in the semiconductor manufacturing industry, the output at any stage is a variable, for example, varying as to supply chain parameters such as quantity, quality and delivery time. Accordingly, orders with downstream suppliers often need to be conditioned upon the results of one or more upstream suppliers.

When information in a supply chain is not accurate and "current", the entire supply chain can become inefficient, subject to distortion and unstable. One of the common distortion problems is escalating over-requirement forecasts that tend to greatly exceed market demand. Such escalation is sometimes referred to as a "bullwhip" effect. The "bullwhip" results when each supplier in the supply chain over states actual demand. The over demand escalates as forecasts are propagated downstream in the supply chain. Each downstream supplier amplifies the over-requirement of the previous stage.

In the FIG. 5 purchase order set, each of the suppliers receives "current" and accurate information from upstream suppliers through use of communications over the Internet. The "current" information helps to reduce supply chain escalation of over requirements.

FIG. 6 depicts another example of a purchase order set for multistage processing in the FIG. 4 system. In FIG. 6, buyer, B_b, initiates operation of the supply chain in connection with a purchase by authorizing input I_2. The input I_2 to the supply chain progresses through a sequence of stages [$P_{0,0}$, $P_{0,1}$, $P_{x,2}$, $P_{x,3}$] to provide the output O_2. The supplier for the stage $P_{0,0}$ stage is S_0, the supplier for the stage $P_{0,1}$ stage is S_1, the supplier for the stage $P_{x,2}$ stage is S_4 and the supplier for

the stages $P_{x,3}$ stage is S_S. In order for the work to be performed through the stages $[P_{0,0}, P_{0,1}, P_{x,2}, P_{x,3}]$ of FIG. 6, orders authorizing and specifying the terms and conditions associated with the work are agreed upon by the buyer, B_b, and the suppliers S_0, S_1, S_4, and S_S. The orders in FIG. 6 are designated $P_{0,0}S_0$, $P_{x,1}S_2$, $P_{1,2}S_3$ and $P_{1,3}S_5$.

In a semiconductor manufacturing environment, the I_2 input is a wafer lot and the processing stages are typically Fab, Wafer Sort, Assembly and Final Test each performed by a supplier and typically the different suppliers S_0, S_1, S_4, and S_S, respectively. The work at each of the processing stages of Fab, Wafer Sort, Assembly and Final Test is authorized and controlled by the orders $P_{0,0}S_0$, $P_{0,1}S_1$, $P_{x,2}S_4$ and $P_{x,3}S_S$, respectively. The output from the stages $[P_{0,0}, P_{0,1}, P_{x,2}, P_{x,3}]$ are represented by $[G_{0,0}, G_{0,1}, G_{x,2}, O_2]$, respectively. In FIG. 6, the set of purchase orders $[P_{0,0}S_0, P_{0,1}S_1, P_{x,2}S_4, P_{x,3}S_S]$ relate to interdependent work steps. The output, O_2, is only obtained when all of the orders $[P_{0,0}S_0, P_{0,1}S_1, P_{x,2}S_4, P_{x,3}S_S]$ have been executed according to their terms and in the sequence from the most upstream order $P_{0,0}S_0$ in turn through the orders $P_{0,1}S_1$, $P_{x,2}S_4$ to the most downstream order $P_{x,3}S_S$.

In the FIG. 6 purchase order set, each of the suppliers receives "current" and accurate information from upstream suppliers through use of communications over the Internet. The "current" information helps to reduce supply chain escalation of over requirements.

FIG. 7 depicts another example of a purchase order set for multistage processing in the FIG. 4 system. In FIG. 7, buyer, B_b, initiates operation of the supply chain in connection with a purchase by authorizing input I_3. The input I_3 to the supply chain progresses through a sequence of stages commencing with a stage $P_{0,0}$ and thereafter split into two sequences, namely, $[P_{x,1}, P_{1,2}, P_{1,3}]$ to provide the output O_3 and $[P_{x+1,1}, P_{0,2}, P_{0,3}]$ to provide the output O_4. The supplier for the stage $P_{0,0}$ stage is S_0, the supplier for the stage $P_{x,1}$ stage is S_2, the supplier for the stage $P_{1,2}$ stage is S_3 and the supplier for the stages $P_{1,3}$ stage is S_5 and the supplier for the

stage $P_{x+1,1}$ stage is S_6, the supplier for the stage $P_{0,2}$ stage is S_7 and the supplier for the stages $P_{0,3}$ stage is S_8. In order for the work to be performed through the stage $P_{0,0}$ an order authorizing and specifying the terms and conditions associated with the work are agreed upon by the buyer, B_b, and the supplier S_0. In order for the work to be performed through the stages $[P_{x,1}, P_{1,2}, P_{1,3}]$ of FIG. 7, orders authorizing and specifying the terms and conditions associated with the work are agreed upon by the buyer, B_b, and the suppliers S_2, S_3 and S_5. In order for the work to be performed through the stages $[P_{x+1,1}, P_{0,2}, P_{0,3}]$ of FIG. 7, orders authorizing and specifying the terms and conditions associated with the work are agreed upon by the buyer, B_b, and the suppliers S_6, S_7 and S_8. The orders in FIG. 7 are designated $[PO_{0,0}S_0]$, $[PO_{x,1}S_2, PO_{1,2}S_3, PO_{1,3}S_5]$ and $[PO_{x+1,1}S_6, PO_{0,2}S_7, PO_{0,3}S_8]$.

In a semiconductor manufacturing environment, the I_3 input is a wafer lot and the processing stages are typically Fab, Wafer Sort, Assembly and Final Test each performed by a supplier and typically the different suppliers $[S_0]$, $[S_2$ and $S_6]$, $[S_3$ and $S_7]$ and $[S_5$ and $S_8]$, respectively. The work at each of the processing stages of Fab, Wafer Sort, Assembly and Final Test is authorized and controlled by the orders $[PO_{0,0}S_0]$, $[PO_{x,1}S_2, PO_{1,2}S_3, PO_{1,3}S_5]$ and $[PO_{x+1,1}S_6, PO_{0,2}S_7, PO_{0,3}S_8]$. The output from the stage $P_{0,0}$ is split and is represented by $[{}_1G_{0,0}$ and ${}_2G_{0,0}]$. The outputs from the stages $[P_{x,1}, P_{1,2}, P_{1,3}]$ are represented by $[G_{x,1}, G_{1,2}, O_3]$, respectively. The outputs from the stages $[P_{x+1,1}, P_{0,2}, P_{0,3}]$ are represented by $[G_{x+1,1}, G_{0,2}, O_4]$, respectively.

In FIG. 7, the sets of purchase orders $[PO_{0,0}S_0]$, $[PO_{x,1}S_2, PO_{1,2}S_3, PO_{1,3}S_5]$ and $[PO_{x+1,1}S_6, PO_{0,2}S_7, PO_{0,3}S_8]$ relate to interdependent work steps. The output, O_3, is only obtained when all of the orders $[PO_{0,0}S_0]$ and $[PO_{x,1}S_2, PO_{1,2}S_3, PO_{1,3}S_5]$ have been executed according to their terms and in the sequence from the most upstream order to the most downstream order. The output, O_4, is only obtained when all of the orders $[PO_{0,0}S_0]$ and $[PO_{x+1,1}S_6, PO_{0,2}S_7, PO_{0,3}S_8]$ have been executed according to their terms and in the sequence from the most upstream order to the most downstream order. Further each of the subset order sequences $[PO_{x,1}S_2, PO_{1,2}S_3,$

$PO_{1,3}S_5$] and [$PO_{x+1,1}S_6$, $PO_{0,2}S_7$, $PO_{0,3}S_8$] are interdependent in that they both drive from the parent order [$PO_{0,0}S_0$].

In the FIG. 7 purchase order set, each of the suppliers receives "current" and accurate information from upstream suppliers through use of communications over the Internet. The "current" information helps to reduce supply chain escalation of over requirements. The FIG. 7 sequences indicate the complexity that arises among suppliers in a multistage supply chain typical of outsourcing in the semiconductor manufacturing industry when only a single buyer, B_b is considered.

FIG. 8 depicts a supply chain management system 1 operating in an environment of multiple buyers (B) 3 including buyers (B_0, B_1, ..., B_b, ..., B_B) 3-1, 3-2, ...3-b, ..., 3-B and multiple suppliers (S) 7 including suppliers (S_0, S_1, ..., S_S) 7-1, 7-2, ..., 7S in a supply chain. The buyers 3 and suppliers 7 are connected to a multi-stage, multi-lot processor 8' that is one embodiment of the global processor 8 of FIG. 1. In FIG. 8, the buyer B_b is typical of all the buyers B_0, B_1, ..., B_b, ..., B_B and buyer B_b places orders and receives goods and services from a multistage supply chain $P\{B_b\}$ 4-b. The multistage supply chain $P\{B_b\}$ is like any of the multistage supply chains described in connection with FIG. 1 through FIG. 7. For the semiconductor manufacturing industry, the multistage supply chain $P\{B_b\}$ includes a plurality of stages P_{bx} organized functionally, for example, into Fab, Wafer Sort, Assembly and Final Test stages. The stages P_{bx} are like any of the stages described in connection with FIG. 1 through FIG. 7. The single buyer B_b is typical and more generally all the buyers B_0, B_1, ..., B_b, ..., B_B are associated with multistage supply chains $P\{B_0\}$, $P\{B_1\}$, ..., $P\{B_b\}$, ..., $P\{B_B\}$, respectively. The stages P_{bx} for any particular one of the supply chains $P\{B_0\}$, $P\{B_1\}$, ..., $P\{B_b\}$, ..., $P\{B_B\}$ may be same as or different from the stages P_{bx} for any other ones of the supply chains $P\{B_0\}$, $P\{B_1\}$, ..., $P\{B_b\}$, ..., $P\{B_B\}$. FIG. 8 indicates the great complexity of the supply chain environment for multiple buyers and multiple suppliers common in many industries such as the semiconductor manufacturing industry.

FIG. 9 depicts a hardware block diagram of a computer system network for the supply chain management system of FIG. 1. In FIG. 9, the CLIENT(BUYER/SUPPLIER) 91-1, the CLIENT(BUYER/SUPPLIER) 91-2 and the CLIENT(BUYER/SUPPLIER) 91-C connect over INTERNET 99 to MULTI-STAGE, MULTI-LOT PROCESSOR 8 and particularly to the SWITCH 92. The SWITCH 92 functions to switch incoming and outgoing traffic between the LOAD BALANCER 93-1 and the LOAD BALANCER 93-2. The LOAD BALANCER 93-1 and the LOAD BALANCER 93-2 connect between the SWITCH 94-1 and the SWITCH 94-2. The SWITCH 94-1 and the SWITCH 94-2 connect to the APPLICATION SERVER 95-1 and the APPLICATION SERVER 95-2. The APPLICATION SERVER 95-1 and the APPLICATION SERVER 95-2 execute programs for performing supply chain management in the multiple buyer, multiple supplier environment. The APPLICATION SERVER 95-1 and the APPLICATION SERVER 95-2 connect through DATA SERVER 96-1 and DATA SERVER 96-2 to the DISK ARRAY 97 which includes the disks MAIL 97-1, DATABASE 97-2 and LOG-IN 97-3. The processor 8 of FIG. 9 includes two-way redundancy for providing highly reliable and highly available supply chain management services to the buyers and suppliers that are the clients in the network.

FIG. 10 depicts a software block diagram for the supply chain management system of FIG. 1. In FIG. 9, the CLIENT (BUYER/SUPPLIER) 91-1, the CLIENT (BUYER/SUPPLIER) 91-2 and the CLIENT (BUYER/SUPPLIER) 91-C connect over INTERNET 99 to MULTI-STAGE, MULTI-LOT PROCESSOR 8 and particularly to the SECURITY/SWITCH 92'. The SECURITY/SWITCH 92' functions to perform security checks on the internet traffic and to switch incoming and outgoing traffic between the WEB 98-1 and the BUSINESS LOGIC 98-2 executing in the PROCESS SERVERS 95'. The WEB 98-1 and the BUSINESS LOGIC 98-2 and the APPLICATION SERVER 95-2 connect to the DATA SERVER 97' which includes MAIL 97'-1, DATABASE 97'-2 and LOG-IN 97-3 functions. The WEB 98-1 process functions are primarily for real-time interactive

communications between the DATA SERVER 97' and CLIENTs 91-1, 91-2, ..., 91-C. The BUSINESS LOGIC 98-2 is primarily for performing the operations necessary for supply chain management services in the multiple buyer, multiple supplier environment. The BUSINESS LOGIC 98-2 is logic means for accessing master information for executing supply chain management functions for the clients to provide management data.

FIG. 11 depicts a CORRELATION PROCESSOR 98'-2 for correlating input and output information among clients. The correlation is among the local and fragmented information that is different for each client. In the particular embodiment of FIG. 11, the CORRELATION PROCESSOR 98'-2 performs mapping and data integrity processing in connection with the supply chain management. In FIG. 11, the CLIENTs 91-1, 91-2, ..., 91-C connect over INTERNET 99 to the CORRELATION PROCESSOR 98'-2. The CORRELATION PROCESSOR 98'-2 is part of the BUSINESS LOGIC 98-2 of FIG. 10. The MESSAGE FILE CONNECTOR 88-1 functions using conventional internet protocols (httpRobot, ftpRobot, ftpServer) for incoming and outgoing communications over the INTERNET 99. The FILE MONITOR 88-2 detects the file format and makes conventional conversion to comma separated values (for example, flat2csv, xls2csv). The CONVERTER 88-3 converts the csv values to an xml format as an input to the INPUT MAPPER 88-4. The INPUT MAPPER 88-4 functions to map the local property values inherent in the input data to master property values defined by the supply chain management system. The INPUT MAPPER 88-4 accesses the PROPERTY TABLES in the DATABASE 97'-2 to do the mapping. After mapping, the mapped raw input data is converted in CONVERTER 88-5 from an xml format to a database format (xml TO db) and stored in the RAW DATA store 88-7_1. The mapped raw input data is then processed in the DATA INTEGRITY UNIT 88-6 including the Data Checking unit 88-6_1 and the Data Cleansing 88-6_2. The checked and cleaned processed input data is stored The checked and cleaned raw data is processed in the PROCESS DATA

UNIT 98 and the processed data is stored in the PROCESSED DATA store 88-7_2. Any of the raw data in the RAW DATA store 88-7_1 or the processed data in the PROCESSED DATA store 88-7_2 can be communicated to the CLIENTs 91-1, 91-2 and 91-C using the OUTPUT MAPPER 88-8 to map the output data to the form expected by the client. The OUTPUT MAPPER 88-8 functions to map the master property information defined by the supply chain management system to the local property information of the type and form used by clients as revealed in the input data from clients. The OUTPUT MAPPER 88-8 is an output mapping means for mapping management data to local data for clients. The OUTPUT MAPPER 88-8 accesses the PROPERTY TABLES in the DATABASE 97'-2 to do the mapping.

Different buyers, such as Fabless semiconductor companies, frequently require different information from their suppliers' daily or other reports. Often suppliers can provide only one format for these reports to all of their buyers due to the constraints in their computer systems. To bridge this information gap, the supply chain management system uses a database schema which provides a master property table holding a super set of information for all the clients (buyers and suppliers) using the system. When the buyers and suppliers send their records, reports and inquiries to the supply chain management system, the data are mapped into the master database schema.

A client-specific property file is created to describe the client-specific ("local") data for each client. In one embodiment, MicroSoft BizTalk is used to generate a schema.biz and mapper.biz to define the mapping between a client's local data and the master database schema. Then, a JAVA class, CSV2XML, is applied to convert these data reports from .DBF, .XLS or .CSV format into XML format files based on the description in the corresponding local property files. The XML style sheet file, .XSL, generated by the mapper.biz and the JAVA class, XML2DB, are used to convert the report data into the final format to be imported into the master table of the database.

The master table can be in any form including indexed files, linked sub-tables, linked lists, among others. The following TABLE 1is an example of a master property table where the column "Field Name" represents the master table name and the column "Description" briefly describes the general use of the Field Name. TABLE 1 is representative of a master table and is not intended to be exhaustive. Other fields are added as the need arises.

TABLE 1
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	Field Name	Description
1	Actual Charge	Charge for Units actually delivered as Final Product
2	Actual Qty	Quantity of Units actually delivered as Final Product
3	Back Issue Die Qty	Back Issued Die Qty
4	Base Lot	Indicator number derived from the lot genealogy specification
5	Bin	Physical bin location
6	Completed Date	Date on which the manufacturing process completes
7	Completed Die Qty	Number of dies completed in the processing
8	Completed Qty	Number of Units completed in the processing
9	Completed Wafer Qty	Number of wafers completed in the processing
10	Date Code	Code to designate the manufacturing date of product
11	Description	Description of process parameters
12	Device Type	Type of device
13	Down Grade Qty	Number of Units being downgraded to lower specs after production
14	Est Amount	Estimated finished goods amount
15	Est_FG_Date	Estimated finished goods date
16	Est_FG_Qty	Estimated finished goods quantity
17	Estimate Complete Date	Revised completion date based on the current process information
18	ETA Date	Date of estimated time of arrival
19	Good Unit Qty	Number of good Units
20	Gross Ship Weight	Gross weight as shipped
21	Hold Date	Date Hold starts
22	Hold Qty	Number of Units on hold
23	I_No	Identification number for product
24	Invoice Date	Invoice created date
25	Invoice No	Invoice number
26	Lot No	Number for Client derived from Base Lot indicator
27	Net Shipping Weight	Net weight as shipped
28	Notes	Special instructions and details
29	Order Confirm Date	Date order confirmed
30	Order Date	Date on which the production order is issued
31	Order Qty	Quantity ordered

TABLE 1
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	Field Name	Description
32	Order Req Date	Date order requested
33	Ordered Die Qty	Ordered die qty
34	Ordered Wafer Qty	Ordered wafer qty
35	Part No	Part number
36	PO No	Purchase Order number
37	PO Rev No	Revolution of PO No
38	Process	Name of detailed process used by Supplier
39	Production Order No	Number for production order
40	Received Date	Date on which Units are received
41	Received Die Qty	Number of die received for the manufacturing process
42	Received Qty	Number of Units received
43	Received Wafer Qty	Number of wafer received for the manufacturing process
44	Return Code	Code used to make a return
45	Return Order No	Number used to make a return
45	Return Qty	Number of Units returned
46	Routing	Name of stage, such as Fab, Wafer Sort, Assembly, Final Test
47	Routing Status	Status such as scheduled, started, active, hold, completed or shipped
48	Scrap Qty	Number of Units being scraped
49	Return Qty	Number of Units being returned
50	Ship Cost	Shipping cost
51	Ship Date	Date of current shipment
52	Ship Qty	Unit quantity in the current shipment
53	Ship Dimension	Dimension of packed shipment
54	Ship Line No	Number on shipping package
55	Ship To	Destination client
56	Ship Via	Carrier name
57	Shipping Notice No	Number on shipping package
58	Start Date	Date on which the processing begins
59	Start Qty	Number of Units when the processing starts
60	Sup	Supplier name
61	Topmark	Topmark visible on top of finished goods

TABLE 1 Copyright 2002 GetSilicon, Inc.		
	Field Name	**Description**
62	Unit	Unit type such as Wafer, Die
63	Unit Price	Unit price per Unit
64	Weighted Completed Date	Weighted completed date, based on the quantity
65	Weighted Received Date	Weighted received date, based on the quantity
66	Weighted Ship Date	Weighted ship date, based on the quantity
67	Weighted Start Date	Weighted start date, based on the quantity
68	WIP Die Qty	Number of dies that is active in the production process
69	WIP Wafer Qty	Number of wafers that is active in the production process
70	WO No	Work Order No
71	WO Rev No	Work Order Rev
72	Yield	Output over input (in percent)

The following TABLE 2, TABLE 3 and TABLE 4 are examples of the master property table and the corresponding local client information mapping. In TABLE 2, the column "Field Name" represents the master table information, the column "Buyer1" represents a buyer client local client information of a buyer and the columns "Fab1", "Wafer Sort1", "Assembly1" and "Test1" represent local client information of four suppliers representing different stages of semiconductor manufacturing.

In TABLE 3, the column "Field Name" represents the master table information, the column "Buyer1" represents local client information of a buyer and the columns "Wafer Sort1" and "Wafer Sort2" represent local client information of two suppliers representing the same Wafer Sort stage of semiconductor manufacturing.

In TABLE 4, the column "Field Name" represents the master table information, the column "Buyer1" represents a buyer client local client information of a buyer and the columns "Assembly1", "Assembly2" and "Assembly3" represent local client information of two suppliers representing the same Assembly stage of

semiconductor manufacturing. Certain ones of the fields in TABLE 1 derive directly from client fields while others are derived as a result of processing.

Examples of derived fields include:

1) *Base Lot*. A derived number indicator used for tracking the lot genealogy for a buyer through all suppliers.

2) *In-Date*. A derived date that is the earliest date associated with any transaction at a client, for example, the earlier of the *Received Date* and the *Start Date*.

3) *Out-Date*. The latest date associated with any transaction at a client, for example, the later of the *Complete Date* and the *Ship Date*.

4) The term *Qty* generally means quantities that have been accumulated to show totals for one or more transactions or parts of a transaction.

5) The term *Weighted* refers to dates weighted by quantity. For example, for 100 pcs received on 6/5/2002 0:0:0 and 200 pcs received on 6/6/2002 0:0:0, the *Weighed Received Date* is: (date1*qty1+date2*qty2)/(qty1+qty2), the *Weighted Received Date* is: 6/5/2002 18:0:0.

6) *Est_FG_Date*. The estimated finished good date, the date which the current material will be available as finished goods. The *Est_FG_Date* is calculated based on the standard cycle time of each stage (routing).

7) *Est_FG_Qty*. The estimated finish good quantity, the expected quantity which the current material becomes the final finish goods. The *Est_FG_Qty* is

calculated based on the expected *Yield* of each stage.

8) *Yield.* Determined as the ratio *Output Qty/Input Qty.*

The derived fields are only by way of example as any number of additional derived fields may be added as the need arises.

TABLE 2

#	Field Name	Buyer1	Fab1	Wafer Sort1	Assembly1	Test1
1	Shipping Notice No	Package NO	Invoice Number	Reference_No	Packing No	Reference No
2	PO No		Customer PO			
3	PO Rev No					
4	WO No	Work Order No		Work Order No	WO Number	Po No
5	WO Rev No	Work Order Rev				
6	Order Line No				Order Line No	
7	Device Type	Device				
8	Part No	Part Num		Part No.	Part Num	Part No
9	I_No	I_No	Customer Device			Product No
10	Bin	BIN				BIN
11	Lot No	CM Lot No	Fab1 Lot ID	Lot No.	Lot No	Lot No
12	Description					
13	Order Date					
14	Order Qty					
15	Order Req Date					
16	Order Confirm Date					
17	UM					

TABLE 2						
#	Field Name	Buyer1	Fab1	Wafer Sort1	Assembly1	Test1
18	Ship Line No	Package NO			Item	N
19	Ship Date	PACKAGE Date		Date	Date	Date
20	ETA Date					
21	Ship Wafer Qty	Qty	Ship Qty	Wafer Shipping QTY	QTY	Qty1
22	Ship Die Qty			Good Die Qty	QTY	Qty2
23	Ship To		Ship To		Ship to Location	To
24	Ship Via				VIA	via
25	Gross Ship Weight				G.W	
26	Net Shipping Weight				N.W	
27	Ship Dimension				Dimension	
28	Ship Cost					
29	Invoice Date	invoice created date		invoice date	inv date	
30	Invoice No	Invoice No Invoice No		Invoice No	Invoice No	Invoice No
31	Notes					
32	Date code			Date Code		
33	Return Order No					
34	Return Code					

TABLE 3				
#	Field Name	Buyer1	Wafer Sort1	Wafer Sort2
1	Shipping Notice No	Package NO	Reference_No	F_SHIP_NO

TABLE 3

#	Field Name	Buyer1	Wafer Sort1	Wafer Sort2
2	PO No			
3	PO Rev No			
4	WO No	Work Order No	Work Order No	F_RELEASE_NO
5	WO Rev No	Work Order Rev		
6	Order Line No			F_RELEASE_NO
7	Device Type	Device	Wafer	
8	Part No	Part Num	Part No.	F_CUST_PN
9	I_No	I_NO		
10	Bin	BIN		
11	Lot No	CM Lot No	Lot No.	F_CUST_LOT_NO
12	Description			
13	Order Date			
14	Order Qty			
15	Order Req Date			
16	Order Confirm Date			
17	Unit			
18	Ship Line No	Package NO		
19	Ship Date	PACKAGE Date	Date	F_MODIFY_DATE
20	ETA Date			
21	Ship Wafer Qty	Qty	Wafer Shipping QTY	F_PIECES
22	Ship Die Qty		Good Die Qty	F_GOOD_DIES
23	Ship To			F_SHIP_TO
24	Ship Via			
25	Gross Ship Weight			
26	Net Shipping Weight			
27	Ship Dimension			
28	Ship Cost			

TABLE 3				
#	Field Name	Buyer1	Wafer Sort1	Wafer Sort2
29	Invoice Date	invoice created date		
30	Invoice No	Invoice No	Invoice No	Invoice No
31	Notes			
32	Date code			
33	Return Order No			
34	Return Code			

TABLE 4				
#	Field Name	Assembly1	Assembly2	Assembly3
1	Shipping Notice No	Package NO	Packing No	SHIPMENT NO
2	PO No			
3	PO Rev No			
4	WO No	WO Num	WO Number	P.O.NUM
5	WO Rev No	WO Rev Num		
6	Order Line No		Order Line No	
7	Device Type	Device Type	Device	DEVICE
8	Part No	Part No	Part Num	
9	I_No			
10	Bin			
11	Lot No	Lot No	Lot No	LOT NUM
12	Description			
13	Order Date			
14	Order Qty			Qty
15	Order Req Date			
16	Order Confirm Date			
17	Unit			
18	Ship Line No		Item	

TABLE 4				
#	Field Name	Assembly1	Assembly2	Assembly3
19	Ship Date	ETA	Date	ETD
20	ETA Date	ETD		ETA
21	Ship Wafer Qty		QTY	
22	Ship Die Qty	QTY	QTY	
23	Ship To	Ship to Loc	Ship to Location	
24	Ship Via	VIA	VIA	FORWARDER
25	Gross Ship Weight	G.W	G.W	WEIGHT
26	Net Shipping Weight	N.W	N.W	
27	Ship Dimension		Dimension	
28	Ship Cost			
29	Invoice Date			
30	Invoice No	Invoice Date	invoice date	
31	Notes	Invoice No	Invoice No	Invoice No
32	Date code			
33	Return Order No			
34	Return Code			

One program for implementing the mapping described is presented in the following TABLE 5.

TABLE 5

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```
<xsl:stylesheet xmlns:xsl='http://www.w3.org/1999/XSL/Transform' xmlns:msxsl='urn:schemas-microsoft-
    com:xslt' xmlns:var='urn:var' xmlns:user='urn:user' exclude-result-prefixes='msxsl var user' version='1.0'>
<xsl:output method='xml' encoding='UTF-8' indent='yes' omit-xml-declaration='yes' />
<xsl:template match='/'>
  <xsl:apply-templates select='INSERT'/>
</xsl:template>
<xsl:template match='INSERT'>
<INSERT>
  <xsl:for-each select='ROWSET_shipHEADER'>
```

TABLE 5
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```
<ROWSET_SHIPHEADER>
<xsl:for-each select='ROW_shipHEADER'>
<ROW_SHIPHEADER>
<!-- Connection from source node "ToID" to destination node "BUYER" -->
<BUYER><xsl:value-of select='ToID/text()'/></BUYER>
<!-- Connection from source node "FromID" to destination node "SUPPLIER" -->
<SUPPLIER><xsl:value-of select='FromID/text()'/></SUPPLIER>
<!-- Connection from source node "reportDate" to destination node "REPORTDATE" -->
<REPORTDATE><xsl:value-of select='reportDate/text()'/></REPORTDATE>
<!-- Connection from source node "tDate" to destination node "TDATE" -->
<TDATE><xsl:value-of select='tDate/text()'/></TDATE>
<!-- Connection from source node "fileName" to destination node "FILENAME" -->
<FILENAME><xsl:value-of select='fileName/text()'/></FILENAME>
<!-- Connection from source node "fileSize" to destination node"FILESIZE" -->
<FILESIZE><xsl:value-of select='fileSize/text()'/></FILESIZE>
<!-- Connection from source node "RecordSize" to destination node"RECORDSIZE"-->
<RECORDSIZE><xsl:value-of select='ancestor::*[2]/RecordSize/text()'/></RECORDSIZE>
<!--Connection from source node "ROW_shipHEADER" to destination node "ROW_SHIPHEADER"-->
<xsl:value-of select='./text()'/>
</ROW_SHIPHEADER>
</xsl:for-each>
<!-- Connection from source node"ROWSET_shipHEADER" to destination node"ROWSET_SHIPHEADER"-->
<xsl:value-of select='./text()'/>
</ROWSET_SHIPHEADER>
</xsl:for-each>
<xsl:for-each select='shipITEM'>
<SHIPITEM>
<xsl:for-each select='ROWSET_ship1'>
<ROWSET_SHIP1>
<xsl:for-each select='ROW_ship1'>
<ROW_SHIP1>
<!-- Connection from source node "LineNumber" to destination node "LINENUMBER" -->
<LINENUMBER><xsl:value-of select='LineNumber/text()'/></LINENUMBER>
<!-- Connection from source node "PO_NO" to destination node "ORDERNO" -->
<ORDERNO><xsl:value-of select='PO_NO/text()'/></ORDERNO>
<!-- Connection from source node "SHP_PRD_NO" to destination node "PARTNO" -->
<PARTNO><xsl:value-of select='SHP_PRD_NO/text()'/></PARTNO>
<!-- Connection from source node "ORD_QTY" to destination node "ORDERQTY" -->
<ORDERQTY><xsl:value-of select='ORD_QTY/text()'/></ORDERQTY>
<!-- Connection from source node "REQ_DATE" to destination node "ORDERREQDATE"-->
<ORDERREQDATE><xsl:value-of select='REQ_DATE/text()'/></ORDERREQDATE>
<!-- Connection from source node "SHIP_DATE" to destination node "SHIPDATE" -->
<SHIPDATE><xsl:value-of select='SHIP_DATE/text()'/></SHIPDATE>
<!-- Connection from source node "SHIP_QTY" to destination node "WAFERQTY" -->
<WAFERQTY><xsl:value-of select='SHIP_QTY/text()'/></WAFERQTY>
<!-- Connection from source node "LAST_DATE" to destination node "INVOICEDATE" -->
<INVOICEDATE><xsl:value-of select='LAST_DATE/text()'/></INVOICEDATE>
<!-- Connection from source node "SO_NO" to destination node "INVOICENO" -->
```

```
58                  <INVOICENO><xsl:value-of select='SO_NO/text()'/></INVOICENO>
59                  <!-- Connection from source node "REMARK" to destination node "NOTES" -->
60                  <NOTES><xsl:value-of select='REMARK/text()'/></NOTES>
61                <!-- Connection from source node "ROW_ship1" to destination node "ROW_SHIP1" -->
62                <xsl:value-of select='./text()'/>
63                </ROW_SHIP1>
64              </xsl:for-each>
65            <!--Connection from source node"ROWSET_ship1"to destination node"ROWSET_SHIP1"-->
66            <xsl:value-of select='./text()'/>
67            </ROWSET_SHIP1>
68          </xsl:for-each>
69          <xsl:for-each select='ROWSET_shipMEMOS'>
70            <ROWSET_SHIPMEMOS>
71              <xsl:for-each select='ROW_shipMEMOS'>
72                <ROW_SHIPMEMOS>
73                  <!--Connection from source node"MEMONAME"to destination node"MEMONAME"-->
74                  <MEMONAME><xsl:value-of select='MEMONAME/text()'/></MEMONAME>
75                  <!-- Connection from source node "MEMO" to destination node "MEMO" -->
76                  <MEMO><xsl:value-of select='MEMO/text()'/></MEMO>
77                <!-- Connection from source node "ROW_shipMEMOS" to destination node"ROW_SHIPMEMOS"-->
78                <xsl:value-of select='./text()'/>
79                </ROW_SHIPMEMOS>
80              </xsl:for-each>
81            <!--Connection from source node"ROWSET_shipMEMOS"to destination node"ROWSET_SHIPMEMOS"-->
82            <xsl:value-of select='./text()'/>
83            </ROWSET_SHIPMEMOS>
84          </xsl:for-each>
85        <!-- Connection from source node "shipITEM" to destination node "SHIPITEM" -->
86        <xsl:value-of select='./text()'/>
87        </SHIPITEM>
88      </xsl:for-each>
89    </INSERT>
90    </xsl:template>
91    </xsl:stylesheet>
```

After the input data has been mapped and stored as raw data as described above and in connection with TABLE 2, TABLE 3, TABLE 4 and TABLE 5, the mapped raw input data is then processed in the DATA INTEGRITY UNIT 88-6 including the Data Checking unit 88-6_1 and the Data Cleansing 88-6_2 to improve the quality of the raw data.

One of the significant barriers to efficient supply chain management is poor data quality. A large amount of the data is provided by suppliers for Fabless semiconductor buyers. The buyers and suppliers (together clients of the supply chain management system) are connected in common over the Internet and the

suppliers supply local supplier information to said system via electronic records and reports. A record is a single entry at one time and reports reflect accumulated data from a number of records or other reports. The data integrity unit of FIG. 11 operates to process the raw data to obtain clean processed data. The clean processed data is checked for consistency with buyer's original local information as well as the local information provided by all the other suppliers in the supply chain.

The data integrity processing is divided into five parts:

Part 1. Data Consistency Within a Record.

Part 2. Data Consistency Within a Report.

Part 3. Data Consistency Across Different Reports from a Particular Supplier.

Part 4. Data Consistency Between Supplier and Buyer Data.

Part 5. Data Consistency Between Suppliers.

In connection with the different parts, the data relates to WIP (Work In Progress) Reports, activity-based Transaction Reports (TR) including Daily Transaction Reports (DTR), Orders including Purchase Orders (PO) and Work Orders (WO), Shipment Reports and Invoices.

For each of Part 1 to Part 5, cleansing is performed for Static Data Consistency and for Dynamic Data Consistency. By way of example, for Static Data Consistency, in a PO, the Lot No, and Part No are checked for consistency. By way of example, for Dynamic Data Consistency, Date Sequence, Quantity Sequence and Routing Sequence are checked.

In connection with Part 1, Data Consistency Within a Record, typically the following are checked:

1. Required Field Missing.
2. Date Sequence Check. For example, the sequence

ordered date <= received date <= start date

<= *completed date* <= *shipped date* is checked where "<=" means "is earlier than".

3. Quantity Sequence Check. For example, the sequence *received qty* ≥ *start qty* ≥ *completed qty* ≥ *shipped qty* is checked where "≥" means "is greater than or equal to".

4. Date out of Reasonable Range. For example, (*current date - start date*) is too large and *estimated completion date* is before the *current date*.

5. Quantity out of Reasonable Range. For example, *scrap* or *downgrade quantity* too big.

6. Status of a Lot Inconsistent with WIP Quantity.

7. Data Dictionary Check. Key data is included and cross-referenced. For example, *device* is not found in *device master table*, *item number* is not found in *item master table*, WIP status key word is not conformed to the pre-defined specification. A master dictionary for each type of data is stored in the master table to enable checking to be performed.

As an example in connection with Part 2, Data Consistency Within a Report, the following are checked:

1. Duplicated Data Check. For example, the same lot appears in more than one record in a WIP or

the same transaction appears twice in a DTR.

2. Date Sequence Error. For example, *complete-out* before *receive-in* transaction in DTR.

3. Status Sequence Error. For example, status sequence should be: *(scheduled)*<*(active* or *hold)*<*(completed* or *closed)* <*(ship* or *closed)* where "< " means prior to.

As an example in connection with Part 3, Data Consistency Across Different Reports from a Particular Supplier, the following are checked:

1. Data Content Inconsistency. For example, *device* or *item* has no changes for the same lot at a different date.

2. Quantity Inconsistency. For example, *total quantity* (WIP + *scrap* + *warehouse*) changes for the same lot on a different date.

3. Date Inconsistency. For example, *start date* or *completion date* changes for the same lot.

4. WIP Movement Error. For example, a lot has been completed then moves back to WIP.

5. Status Sequence Error. For example, a lot moves to *complete* before becomes *active*.

6. Abnormally Long Cycle Time.

7. Abnormally Low Yield.

As an example in connection with Part 4, Data Consistency Between Supplier and Buyer's Data, the following are checked:

1. Date Sequence Error. For example, a downstream supplier received before the upstream supplier shipped.
2. WIP Movement Error. For example, the same lot appears at two different suppliers at the same time.
3. Status Sequence Error
4. Abnormal Long Cycle Time
5. Shipped but Not Received
6. Shipped Quantity Does Not Equal Received Quantity

As an example in connection with Part 5, Data Consistency Between Suppliers, the following are checked:

1. Consistency Between Purchase Order and Work Order. For example, *device* and *item no* should be consistent; sum of *work order cost* should be equal or less than the *blanket purchase order* amount.
2. Consistency Between WIP and Production Order. For example, *Production Order No*, *Device*, *Item No*, and *Qty* in WIP should match with the production order information.
3. Consistent Between DTR and Production Order. For example, production order no, *device*, item no, and *qty* in DTR should match with the production order information.
4. Consistency Between WIP and DTR. For example, the difference in WIP between the two consecutive dates should be equal to amounts shown in DTR.

5. Consistency Between DTR and Shipment Report.
6. Consistency Between DTR and Inventory. For example, the Inventory report should be equal to the results obtained by the cumulative DTR.

FIG. 12 depicts one example of a multiple supplier branch in a supply chain transaction where after the Wafer Sort stage by supplier *testa*, the Assembly stage for a lot is distributed to three suppliers, namely *pkgk*, *pkgz* and *pkgftp*.

In FIG. 12, the Raw Material is an input to the Fab stage at supplier *fabc* and Lot No T0239A is assigned. When the Fab stage work is complete, a Wafer Shipping Notice is issued and the wafers are delivered for the Wafer Sort stage to supplier *testa* for the Lot No T0239A. When the Wafer Sort stage work is complete, a Sorted Wafer Shipping Notice is issued and the scribed wafers are delivered for the Assembly stage to Assembly supplier *pkgk* with Lot No T0239A-1 assigned, are delivered for the Assembly and Final Test stages to Assembly & Final Test supplier *pkgz* and Lot No T0239A-2 is assigned, and delivered for the Assembly and Final Test stages to Assembly & Final Test supplier *pkgftp* and Lot No T0239A-3 is assigned. When the Assembly supplier *pkgk* with Lot No T0239A-1 completes the packaging, a Assembled Die Shipping Notice is issued and the packaged devices are delivered for the Final Test stage to the Final Test supplier *pkgftp* with Lot No T0239A-1 retained. When the Final Test supplier *pkgftp* finishes the Final Test on Lot No T0239A-1, the Finished Goods are available. When the Final Test supplier *pkgz* finishes the Final Test on Lot No T0239A-2 , the Finished Goods are available. When the Final Test supplier *pkgftp* and finishes the Final Test on Lot No T0239A-3, the Finished Goods are available.

FIG. 13 depicts cross supplier error checking in the example of FIG. 12. The Wafer Sort stage supplier *testa* for the Lot No T0239A-2 has an Out Date, indicated by 2* in FIG. 13, of 2/28/2002 where the designated supplier is *pkgz* . The supplier *pkgz* for the Lot No T0239A-2, however, has an In Date, indicated by

2* in FIG. 13, of 1/28/2002 which of course is an error since the goods could not have been received by *pkgz* before they were shipped by *testa*. This error is detected by the DATA INTEGRITY UNIT 88-6 of FIG. 11.

In FIG. 13, the Assembly stage supplier *pkgk* for the Lot No T0239A-1 has a QTY/die Out quantity, indicated by 1* in FIG. 13, of 3200 where the designated supplier is *pkgftp*. The supplier *pkgftp* for the Lot No T0239A-1, however, has a QTY/die In quantity, indicated by 1* in FIG. 13, of 4200 which of course is an error since more goods could not have been received by *pkgftp* then were shipped by *pkgk*. This error is detected by the DATA INTEGRITY UNIT 88-6 of FIG. 11.

FIG. 14 depicts one example of a lot tracking report. Lot Tracking is executed by the BUSINESS LOGIC 98-2 of FIG. 10 to store detailed information related to a lot in the production supply chain. The information tracked in the lot tracking has two categorizes as follows:

Category 1. Static Data: where the data are fixed during the manufacturing processes.

Category 2. Dynamic Data: where the data can be changed during the manufacturing processes.

The Static Data includes:

a) Lot number,
b) Part no,
c) Purchase order no,
d) Production order no,
e) Date code,
f) Supplier,
g) Routing,
h) Order date,
i) Order Qty,
j) Unit Price,

The Dynamic Data includes two main parts, namely, Date Information and Qty Information where they have the following subparts :

a) Date Information:
   1) Received date
   2) Start date
   3) Hold date
   4) Completed date
   5) Ship date

b) Qty Information
   1) Received Qty
   2) Returned Qty
   3) Start Qty
   4) Hold Qty
   5) Completed Qty
   6) Good part Qty
   7) Scrap part Qty
   8) Downgrade Qty
   9) Ship Qty

Lot tracking records the flow of a lot by keeping its genealogy in order to track the lot history. These records include a parent-child relationship for the unsplit lots and include a sibling relationship for split lots. Lot tracking information is loaded, for example, using WIP or DTR information. Lot tracking keeps a complete and consistent data set for all the production and finance related information in one central place, that is, in the 97'-2 of FIG. 11. With this common repository of lot information for the entire supply chain, performance checking (such as cycle time and yield analysis) and detailed cost reports down to the lot details are provided supply chain management system.

In lot tracking and as shown in the FIG. 14, the supply chain management system assigns a Base Lot indicator number to every lot. In FIG. 14, that Base Lot number is N1805 and a Lot No related to the Base Lot number is also kept so that the routing to and local identification for each of the suppliers is recorded in the lot tracking information. The particular Base Lot number N1805 of FIG. 14 has a ROUTE that traces the sequence Fab at supplier *fabc* with Base Lot number N1805, Wafer Sort at supplier *testa* with Base Lot number N1805, Assembly at supplier *pkgk* with Lot No N18058 and Final Test at supplier *pkgftp* with Lot No N18058.1, with Lot No N18058.2 and with Lot No N18058.3.

FIG. 15 depicts a first cross supplier lot tracking example. In FIG. 15, the Raw Material is an input to the Fab stage at supplier *fabc* and Lot No N1805 is assigned. When work at the Fab stage is complete, a Wafer Shipping Notice is issued and the wafers are delivered for the Wafer Sort supplier *testa* for the Lot No N1805. When the Wafer Sort stage work is complete, a Sorted Wafer Shipping Notice is issued and the sorted wafers are delivered for the Assembly stage to Assembly supplier *pkgk* with Lot No N1805S assigned. When the Assembly supplier *pkgk* with Lot No N1805S completes the packaging, an Assembled Die Shipping Notice is issued and the packaged devices are delivered for the Final Test stage to the Final Test supplier *pkgftp* with Lot No N1805S.1, Lot No N1805S.2 and Lot No N1805S.3 assigned. When the Final Test supplier *pkgftp* finishes the Final Test on Lot No N1805S.1, Lot No N1805S.2 and Lot No N1805S.3, the Finished Goods are available for each of those lots.

FIG. 16 depicts a second cross supplier lot tracking example. In FIG. 15, the Raw Material is an input to the Fab stage at supplier *fabc* and Lot No T0239A is assigned. When the Fab stage work is complete, a Wafer Shipping Notice is issued and the wafers are delivered for the Wafer Sort stage to supplier *testa* for the Lot No T0239A. When the Wafer Sort stage work is complete, a Sorted Wafer Shipping Notice is issued and the sorted wafers are split into three orders and are delivered for the Assembly stage to Assembly supplier *pkgk* with Lot No T0239A-1

assigned, are delivered for the Assembly stage to Assembly supplier *pkgz* with Lot No T0239A-2 assigned and are delivered for the Assembly stage to Assembly supplier *pkgftp* with Lot No T0239A-3 assigned. When the Assembly supplier *pkgk* with Lot No N1805S completes the packaging, a Assembled Die Shipping Notice is issued and the packaged devices are delivered for the Final Test stage to the Final Test supplier *pkgftp* with Lot No N1805S.1, Lot No N1805S.2 and Lot No N1805S.3 assigned. When the Final Test supplier *pkgftp* finishes the Final Test on Lot No N1805S.1, Lot No N1805S.2 and Lot No N1805S.3, the Finished Goods are available for each of those lots.

FIG. 17 depicts an Actual Cost - Lot Detail Report for the Lot No N18005S.1 from Final Test Supplier *pkgftp* of FIG. 15. The ability of the supply chain management system to run the FIG. 15 reports results from the Lot Tracking that is performed. In order to perform Lot Tracking, the mapping of fragmented information among multiple Suppliers is required. The accuracy of the report depends on the accuracy of the information and hence the data integrity processing is important to report accuracy.

FIG. 18 depicts the purchase order logic flow for creation and acceptance of orders. Such orders are of the type described in connection with FIG. 5, FIG. 6 and FIG. 7 where a buyer issues a set of dependent purchase orders in order to progress Raw Materials to Finished Product. As a first step, a Buyer will initiate the process Buyer Create BPO entry at A to create a blanket purchase order. The terms of the BPO are set and may be a standard contract with standard terms and conditions of the Buyer. Normally, the BPO undergoes one or manger approvals for the Buyer usually based upon price thresholds for each manager. The higher the price, the more management levels that may be required. No Manager1Approve ? is required if the price is less than a first threshold, Price $\leq$ \$T1, and a Yes results sending the BPO to the Supplier input C. If the BPO price is not less than a first threshold, Price $\leq$ \$T1, and a No results, a Manager1Approve ? is required and if a No results, a return is made for further adjustment of the BPO. If a

Manager1Approve ? is required and is Yes, the approval process continues for one or more additional approvals. For example, when no Manager2Approve ? is required (the price is less than a second threshold, Price $\leq$ $T2) and a Yes results sending the BPO to the Supplier input C. If the BPO price is not less than a second threshold, Price $\leq$ $T2, and a No results, a Manager2Approve ? is required and if a No results, a return is made for further adjustment of the BPO. If a Manager2Approve ? is required and is Yes, the approval process continues for one or more additional approvals. Assuming Manager2Approve ? is the last required and a Yes results sending the BPO to the Supplier input C.

If a BPO exists, or in the absence of a BPO if one is not to be used, a Buyer from time to time will initiate the process Buyer Create PO entering at B to create a purchase order. The terms of the PO are set and may be a standard contract with standard terms and conditions under the BPO of the Buyer or otherwise. As a first step, a Conditions OK? check is made to make sure that conditions are properly established for the PO. If the current PO is dependent upon the output of another stage, perhaps from a different Supplier, the conditions precedent for the PO are checked and if satisfied, a Yes will forward to a Terms OK? check and if not a No will return to PO for further processing. As a second step, a Terms OK? check is made to make sure that terms of the PO are correct. For example, if the PO is under a BPO, then a check is typically made to determine if the quantity and cost is within the balance remaining on the BPO. If the terms for the PO are checked and if satisfied, a Yes will forward to a Terms Adjust where, for example, the amount of the current PO will decrement the balance remaining on the BPO. If the Terms OK? check is not satisfactory, a No will return to PO for further processing. Normally, the PO undergoes one manger approval Manager0 Approve? and if a Yes results, the processing is sent to the Supplier input C and if No, process is sent to PO for further processing of the PO

When a Supplier receives a Supplier Accept BPO/PO input, entering at C to create approval of a Buyer purchase order. The terms of the PO are set and may

be a standard contract with standard terms and conditions under the BPO of the Buyer or otherwise. As a first step, a BPO Terms OK? check is made to make sure that terms are properly established for the PO or BPO. If the terms of the BPO are OK, a Yes will forward to a Terms OK? check and if not a No will return to BPO/PO for further processing. As a second step, a PO Terms OK? check is make to make sure that the terms of the PO are correct and if Yes will forward processing for manager approval. If the Terms OK? check is not satisfactory, a No will return to BPO/PO for further processing. Normally, the PO undergoes one manger approval Manager Approve? and if a Yes results, the processing terminates with Order Confirmed.

FIG. 19 depicts an example of Final Test Purchase Order. The PO of FIG. 19 is in an on-line form to Supplier *pkgftp* and includes in the lower right-hand corner a thumbnail image of an attachment that details certain aspects of the PO. The ability of the supply chain management system to run reports of the FIG. 19 type relies upon the Lot Tracking facility. In order to perform Lot Tracking, the supply chain management system maps fragmented information that inherently is fragmented among multiple Suppliers since there is no agreed upon standard in the industry. As described, the local information for each client (Buyers and Suppliers) is mapped with reference to a master table that constitutes a super set of all the local tables for each of the clients. The accuracy of each report depends on the accuracy of the mapped information and hence the data integrity processing is important in order to be able to have reporting accuracy among multiple Suppliers and among multiple Buyers and multiple Suppliers.

FIG. 20 depicts an example of the attachment that appears as a thumbnail image in the Final Test Purchase Order of FIG. 19.

FIG. 21 depicts an example of a Wafer Rolling Output Report. . The ability of the supply chain management system to run reports of the FIG. 21 type relies upon the Lot Tracking facility. In order to perform Lot Tracking, the supply chain management system maps fragmented information that inherently is fragmented

among multiple Suppliers since there is no agreed upon standard in the industry. As described, the local information for each client (Buyers and Suppliers) is mapped with reference to a master table that constitutes a super set of all the local tables for each of the clients. The accuracy of each report depends on the accuracy of the mapped information and hence the data integrity processing is important in order to be able to have reporting accuracy among multiple Suppliers and among multiple Buyers and multiple Suppliers.

FIG. 22 depict an example a Finished Goods Rolling Output Report. . The ability of the supply chain management system to run reports of the FIG. 22 type relies upon the Lot Tracking facility. In order to perform Lot Tracking, the supply chain management system maps fragmented information that inherently is fragmented among multiple Suppliers since there is no agreed upon standard in the industry. As described, the local information for each client (Buyers and Suppliers) is mapped with reference to a master table that constitutes a super set of all the local tables for each of the clients. The accuracy of each report depends on the accuracy of the mapped information and hence the data integrity processing is important in order to be able to have reporting accuracy among multiple Suppliers and among multiple Buyers and multiple Suppliers.

FIG. 23 depicts an example a Work in Progress Inventory Report. The ability of the supply chain management system to run reports of the FIG. 23 type relies upon the Lot Tracking facility. In order to perform Lot Tracking, the supply chain management system maps fragmented information that inherently is fragmented among multiple Suppliers since there is no agreed upon standard in the industry. As described, the local information for each client (Buyers and Suppliers) is mapped with reference to a master table that constitutes a super set of all the local tables for each of the clients. The accuracy of each report depends on the accuracy of the mapped information and hence the data integrity processing is important in order to be able to have reporting accuracy among multiple Suppliers and among multiple Buyers and multiple Suppliers.

In the supply chain management system, an alert process is provided that extends across the multiple Suppliers environment and the multiple Buyers and multiple Suppliers environment. Typically, a Buyer having an integrated circuit (IC) design relies upon Production Engineers, Production Control Engineers or other Production Control (PC) personnel to find problems and exceptions that require action or correction during manufacture and procurement. Procurement from a manufacturing supply chain having multiple dependent suppliers, that is, where the output from one Supplier is the input for other Suppliers, has increased complexity when compared with less interdependent supply chains. If a Buyer can only use the Finished Product to solve problems, the job is tedious and error prone. The alert function is robust and extends to all stages in the supply chain. The alert function as one of the supply chain management functions greatly enhances problem identification and correction in the supply chain.

The supply chain management system performs alert processes based upon alert conditions for specific events/reports/process. The alert conditions are selected by clients. Alert reports are accessible to clients through onscreen operations or through other i-commerce methods of communication. Typically, alert conditions are communicated daily (or more frequently if desired) from the supply chain management system to clients in the form of event generation and alert messages.

By way of an example for the alert functions, it is assumed for purposes of explanation that for a particular part (PROD), in the process of P, the standard production cycle time is X days. The production control (PC) personnel, or production control (PC) agent if an automated computer system, of a client specifies that if the *real cycle time* is longer than the *standard cycle time* by Y days, the client is to be alerted. The supply chain management system implements the algorithm as follows in TABLE 6:

TABLE 6

Store info by PROD, P, X (static info)
Store info by PC, Y (Client dependent)
Periodically check the rule (for example, each time a production report enters the supply chain management system) as follows:
If report has product PROD
If report is for process P
If reported *completion time - start time* > X
Store this record into *Cycle* > *stdCycleTime*
With *CycleTime* = *completion time - start time*
With product = PROD
With process = p
When client (PC) accesses report,
If client is PC
List any existing records in *stdCycleTime*
Where product = PROD
AND process = p
AND *CycleTime* > *Y*.

The implementation of TABLE 6 is suitable for both standard reports and client preferences for improved performance.

Alerts are divided into categories:

1) Abnormal time lapse:

a. *Long Queue-in Time*: The *Queue-in Time* is the period from receiving material *(Received Date)* to the start of the production (*Start Date*). A *Long Queue-in Time is* when the *Queue-in Time* is longer than a specified period. Usually a *Long Queue-in Time* results from a constraint in production capacity or a delay in paper work.

b. *Long In-process Time*: The *In-process Time* is the amount of time in a production process,

WIP, and a *Long In-process Time* is when the *In-process Time* is taking an abnormally long time.

A Buyer or other client may define a threshold for 'long cycle time' (per routing stage) and the supply chain management system reports any active WIP beyond the specified threshold as a *Long In-process Time.*

c. *Long On-hold Time*: The *On-hold Time* is time when a production process, WIP, is put on hold due to a quality issue, a machine setup problem, a buyer request or other reason. A Buyer or other client may define a threshold for 'long hold time' (per routing stage) and the supply chain management system reports any active WIP beyond the specified threshold as a *Long On-hold Time.*

d. *Long In-house Warehouse Time*: During and after the production process, WIP, the materials or finished goods are usually put in the supplier's warehouse for temporary storage. This storage is called *In-house Warehouse Time* (also Die/Wafer bank time). A *Long In-house Warehouse Time* is when the *In-house Warehouse Time* is too long. A Buyer or other client may define a threshold for 'long in-house warehouse time' and the supply chain management system reports any storage beyond the specified threshold as a *Long In-house Warehouse Time.*

e. *Long In-transit Time*: The *In-transit Time* is the time lapse between the shipping of one supplier to the receiving of the following supplier. In-transit goods

and materials generally are the most difficult to track in a supply chain. A Buyer or other client may define a threshold for 'in-transit time' and the supply chain management system reports any storage beyond the specified threshold as a *Long In-transit Time*. The supply chain management keeps a log of how long it takes from shipping to receiving at each stage.

f. *Early Complete Notice* – An early warning (x-days before the estimated completion date) is provided to enable a PC to start planning the production flow. This feature is important for Fab and Wafer Sort stages.

g. *Stationary Lot Report* – A log to show lot movement during a given period.

2) Abnormal yield

a. *Low Yield Threshold* is defined by the Buyer or other client. The supply chain management system tracks yield down to per device, per part number, per supplier and identifies low yield.

b. *Excess Yield Threshold.* Sometimes, a supplier reports the output quantity larger than reasonable, such as greater than the input quantity causing a yield greater than 100%.

3) Order and invoice

a. *Missing PO.* When material is set aside for a manufacturing process, the accompanying PO has to be there for suppliers to start the work. However, this is not always done. The supply chain management

system generates alerts for PC in these cases. The trigger can be set in any stage of the production flow: for example, when the upstream process is completed, or when the upstream production is shipped, or when the material is received.

b. *Cost Approval Delay.* When the production process is finished, the cost needs to be calculated and approved by PCs. If the cost calculation and approval process has too great a delay, it is difficult for PC to reconcile this info with the real production data, since it has been done a long time ago. The supply chain management system brings the cost calculation and approval process to alert the PC as soon as a particular process is done, it can reduce the future dispute and control the production cost.

c. *Cost Deviation.* If the unit cost of a particular unit is larger than a particular percentage of the standard cost for such unit, the supply chain management system will bring alert the PC, it can either be due to a low yield, or due to high unit cost.

d. *Received but PO Not Issued* – Lot received but PO has not been issued.

e. *Shipped but PO for next Stage Not Issued* – Lot shipped but PO has not been issued for the following supplier.

f. *Completed but PO Not Closed* – WIP status is completed and PO is not closed.

g. *Completed but Invoice Not Approved* – WIP status is completed, invoice is received and waiting for approval.

h. *Wip Quantity Larger than Ordered Quantity* – WIP quantity should be equal or less than order quantity, this check is particularly important for foundry PO/WIP reconciliation.

4) Performance Index (After the production is done):

a. *Yield Report* – per device, part number, routing and supplier.

b. *Cycle Time Report* – per device, part number, routing and supplier.

The supply chain management system employs planning based upon upstream visibility in the supply chain. Such capabilities are particularly useful in outsourcing to suppliers in a semiconductor supply chain. In the semiconductor IC-design outsourcing industry, the buyer (IC-design house) deals with multiple suppliers that provide various outsourcing functions at different supplier stages. The buyer places a separate order (Purchase Order) with each supplier. Although the Purchase Orders are separate between a buyer and each supplier, each supplier depends on the previous supplier (upstream supplier) in the supply chain. In order to procure a chip as finished goods, a buyer first orders wafers from a Fab supplier (foundry); once the work at the Fab supplier is finished, the buyer orders sorting from a Wafer Sort supplier; after the Wafer Sort work is finished, the buyer orders Assembly from an Assembly supplier; and finally, the buyer orders Final Test from a Final Test supplier. The supply chain management system, for example, is able to perform group order generation for groups of dependent suppliers (Fab, Wafer Sort, Assembly and Final Test suppliers) in the supply chain.

At each step of the supply chain, a downstream supplier waits for the previous upstream supplier to complete (or partially complete) its work before

commencement of work under a new order can begin. The supply chain management system allows the buyer to create virtual downstream orders once upstream orders are underway. The supply chain management system uses estimated date (and continuously update as more up to date info is provided with the WIP data), to create virtual (future) orders for the downstream suppliers.

Besides providing the buyer with order creation, the supply chain management system also provides the suppliers with up to date information regarding up coming orders. Downstream suppliers can use the supply chain management system to view the current status of the materials, which will eventually be arriving and requiring their services.

In an example for describing the operation, a buyer has a requirement for final goods (FG) of amount Q chips on date D. Based upon this information, the supply chain management system operates as in the following TABLE 7:

TABLE 7

Calculate the initial wafer required:
Using Bill of Routing:
FG is made from FT-FG in Final Test with standard yield Yft, standard cycle time Dft, by supplier Sft,
Thus the date and quantity to start FT is:
Q-FT = Q / Yft
FTD = D - Dft
FT-FG is made from AS-FG in Assembly with standard yield Yas, standard cycle time Das, by supplier Sas,
Thus the date and quantity to start AS is:
Q-AS = Q-FT / Yas = Q / Yft / Yas
ASD = FTD - Das = D - Dft - Das
AS-FG is made from WS-FG in Wafer Sort with standard yield Yws, standard cycle time Dws, by supplier Sws,
Q-WS = Q-AS / Yws = Q / Yft / Yas / Yws
WSD = ASD - Dws = D - Dft - Das - Dws
WS-FG is made from FD-FG in Foundry, with wafer to die ratio W2D, with standard cycle time Dfd, by supplier Sfd,
Thus the date and quantity to start FD is:
Q-FD = Q-WS / W2D = Q / Yft / Yas / Yws / W2D
FDD = WSD - Dfd = D - Dft - Das - Dws - Dfd
(for each lot there are 25 wafers)
QL-FD = Q-FD / 25

According to TABLE 6, the supply chain management system will generate orders for each of the suppliers with the proper quantity and required date (WS/AS/FT work orders are lot based).

Since the supply chain management system is connected to the supply chain management system Lot Tracking engine, which keeps track on all the WIP data, the supply chain management system will constantly update the Quantity and Date information in each of the subsequent orders.

Once those orders are generated, the buyer will be notified a few days (user specified) before the next order is needed to be submitted to the supplier. The user

can then come to the supply chain management system and reconfirm the order and submit it. The entire process is automatic and accurate, and greatly increases the productivity of PC personnel of the IC-design company.

While the invention has been particularly shown and described with reference to preferred embodiments thereof it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention.

CLAIMS

1. (Original) A supply chain management system for clients that include one or more buyers and a plurality of suppliers where said one or more buyers place orders with a plurality of said suppliers for the processing of an input to an output, wherein said input is one or more lots, through a plurality of supplier stages where said clients each use fragmented different local information particular to each of said clients, the improvement characterized by,

a database store for storing local information for each of said clients,

correlating means for correlating the local information with mapped data among said clients and forming master information, said correlating means including one or more base lot indicators, one for each of said one or more lots, used in common for all of said stages,

logic means for executing supply chain management functions for tracking said lots through said supplier stages using said base lot indicators.

2. (Original) A supply chain management system for clients where the clients include a plurality of buyers and a plurality of suppliers, where said buyers place orders with a plurality of suppliers for the processing of an input to an output through a plurality of supplier stages, said clients each using fragmented different local information particular to each of said clients, the improvement characterized by,

network communication means for interconnecting said clients for maintaining said local information current in said supply chain management system,

a database store for storing master information in one or more tables having master information correlated to local information,

global processing means for processing supply chain management information for all of said clients including,

correlation means for correlating said local information among said clients, said correlation means including,

input mapping means for mapping said local information for each of said clients as mapped data to provide master information for storage in said database store, said mapping means using base lot indicators, one for each of said one or more lots, in common for all of said stages,

logic means accessing the master information for executing supply chain management functions for tracking said lots through said

supplier stages and providing management data,

output mapping means for mapping said management data into local data for said clients.

3. (Original) The system as in either one of Claims 1 and Claims 2 including means for connecting with clients through the Internet.

4. (Original) The system as in either one of Claims 1 and 2 including tables storing correlations between said master information and said local information for each of said clients.

5. (Original) The system as in either one of Claims 1 and 2 wherein said correlation means includes data integrity means having data checking means for detecting errors in said mapped data.

6. (Original) The system as in either one of Claims 1 and 2 wherein said correlation means includes data integrity means having data cleansing means for correcting errors in said mapped data.

7. (Original) The system as in either one of Claims 1 and 2 wherein said input is a lot.

8. (Original) The system as in either one of Claims 1 and 2 wherein said input is a lot and said lot is split at any one of said stages to two or more different stages performing the same type of processing.

9. (Original) The system as in either one of Claims 1 and 2 wherein said input is lots and wherein said lots, at any two or more of said stages performing the same type of processing, are combined for processing in a downstream stage.

10. (Original) The system as in either one of Claims 1 and 2 wherein suppliers supply local supplier information via electronic records.

11. (Original) The system as in either one of Claims 1 and 2 wherein suppliers supply local supplier information to said system via data in electronic records and reports and wherein said correlation means includes data integrity means that operates to check for data consistency within records, data consistency within reports, data consistency across different reports from a particular supplier, data consistency among data from multiple suppliers and one or more buyers, data consistency among data from multiple suppliers.

12. (Original) The system as in either one of Claims 1 and 2 wherein said clients are in the semiconductor manufacturing industry and said supplier stages include one or more of Fab, Wafer Sort, Assembly and Final Test for processing from the input to the output.

13. (Original) The system of Claim 12 wherein said supplier stages include Fab, Wafer Sort, Assembly and Final Test and one or more additional stages.

14. (Original) The system of Claim 13 wherein said one or more additional stages include one or more of Packaging, Bumping and Marking.

15. (Original) The system of Claim 12 wherein said input is a lot.

16. (Original) The system of Claim 12 wherein said input is a wafer lot.

17. (Original) The system of Claim 12 wherein said input is a die lot.

18. (Original) The system of Claim 12 wherein said output is finished goods.

19. (Original) The system of Claim 12 wherein said output is dies.

20. (Original) The system as in either one of Claims 1 and 2 wherein said input includes a plurality of lots, wherein said database stores one or more tables for correlations between said master information and said local information for each of said buyers and suppliers for each of said lots and wherein each of said tables has unique ones of said base lot indicators common to all tables for identifying said lots.

21. (Original) The system as in either one of Claims 1 and 2 wherein said input includes a plurality of lots, wherein said database stores one or more tables for correlations between said master information and said local information for each of said buyers and suppliers for each of said lots and wherein each of said tables has unique ones of said base lot indicators common to all tables for identifying said lots and wherein each of said stages has an additional lot number for each base lot indicator whereby the combination of said base lot indicator and the lot number represents the genealogy of said lots in said stages.

22. (Original) The system as in either one of Claims 1 and 2 wherein said input is a lot, wherein said database stores one or more tables for correlations between said master information and said local information for each of said buyers and suppliers and wherein each of said tables has a base lot indicator common to all tables for identifying said lot.

23. (Original) The system of Claim 22 wherein said local information is RosettaNet information.

24. (Original) The system of Claim 22 wherein said clients are in the semiconductor manufacturing industry and said supplier stages for each lot include one or more of Fab, Wafer Sort, Assembly and Final Test.

25. (Original) The system of Claim 22 wherein said supplier stages for one or more of said lots is split among multiple Fab stages.

26. (Original) The system of Claim 22 wherein said supplier stages for one or more of said wafer lots is split among multiple Wafer Sort stages.

27. (Original) The system of Claim 22 wherein said supplier stages for one or more of said wafer lots are split among multiple Assembly stages.

28. (Original) The system of Claim 22 wherein said supplier stages for one or more of said wafer lots is split among multiple Final Test stages.

29. (Original) The system as in either one of Claims 1 and 2 wherein said clients are in the semiconductor manufacturing industry and said input is a wafer lot and wherein said supply chain management functions provide a lot tracking report based upon said lot data.

30. (Original) The system of Claim 29 wherein said lot data is static data.

31. (Original) The system of Claim 30 wherein said static data includes Date Code, Lot No, Order Date, Order Qty, PO No, Routing, Sup, and Unit Price.

32. (Original) The system of Claim 29 wherein said lot data is dynamic data.

33. (Original) The system of Claim 32 wherein said dynamic data includes Date Information and Quantity Information.

34. (Original) The system of Claim 33 wherein said Date Information includes Completed Date, Hold Date, Received Date, Ship Date and Start Date.

35. (Original) The system of Claim 33 wherein said Quantity Information includes and Completed Qty, Hold Qty, Received Qty,Ship Qty and Start Qty.

36. (Original) The system as in either one of Claims 1 and 2 wherein said clients are in the semiconductor manufacturing industry and said input is a wafer lot and said output is a chip product and wherein said supply chain management functions include an actual cost lot detail report.

37. (Original) The system as in either one of Claims 1 and 2 wherein said clients are in the semiconductor manufacturing industry and said input is a wafer lot and said output is a chip product and wherein said supply chain management functions include a wafer rolling output report.

38. (Original) The system as in either one of Claims 1 and 2 wherein said clients are in the semiconductor manufacturing industry and said input is a wafer lot and

said output is a chip product and wherein said supply chain management functions include a finished goods rolling output report.

39. (Original) The system as in either one of Claims 1 and 2 wherein said clients are in the semiconductor manufacturing industry and said input is a wafer lot and said output is a chip product and wherein said supply chain management functions include a work in progress inventory report.

40. (Original) The system as in either one of Claims 1 and 2 wherein said clients are in the semiconductor manufacturing industry and said input is a wafer lot and said output is a chip product and wherein said supply chain management system functions to include an alert to signal a condition in the supply chain management system.

41. (Original) The system as in either one of Claims 1 and 2 wherein,

said buyers, B, include buyers B_0, B_1, ..., B_b, ..., B_B,

said suppliers, S, include suppliers S_0, S_1, ..., S_s, ..., S_S,

said stages, P, include stages $[P_{0,0}, P_{0,1}, ..., P_{0,N}]$; $[P_{1,0}, ...]$;$[..., P_{m,n}, ...]$; $[P_{M,0}, ..., P_{M,N}]$.

42. (Original) The system of Claim 41 wherein each of said stages, P, includes up to T transactions, T_0, T_1, ..., T_T.

43. (Original) The system of Claim 42 wherein said T transactions are ORDER, WIP, YIELD, SHIPMENT, RECEIVE, WAREHOUSE and PAYMENT.

44. (Original) A method of chain management for clients that include one or more buyers and a plurality of suppliers where said one or more buyers place orders with a plurality of said suppliers for the processing of an input to an output, wherein said input is one or more lots, through a plurality of supplier stages where said clients each use fragmented different local information particular to each of said clients, the improvement characterized by,

storing local information for each of said clients in a database store,

correlating the local information with mapped data among said clients and forming master information, said correlating means including one or more base lot indicators, one for each of said one or more lots, used in common for all of said stages,

executing supply chain management functions for tracking said lots through said supplier stages using said base lot indicators.

45. (Original) A method of supply chain management for clients where the clients include one or more buyers and a plurality of suppliers, where said one or more buyers place orders with ones of said suppliers for the processing of an input to an output through a plurality of supplier stages, said clients each using fragmented different local information particular to each of said clients, the improvement characterized by,

mapping said local information for each of said clients to provide mapped data,

executing data integrity processes on said mapped data to improve the reliability of said mapped data,

processing said mapped data to provide processed data,

storing the mapped data and the processed data as master information,

accessing the master information to execute supply chain management functions for said clients.

FIG. 1

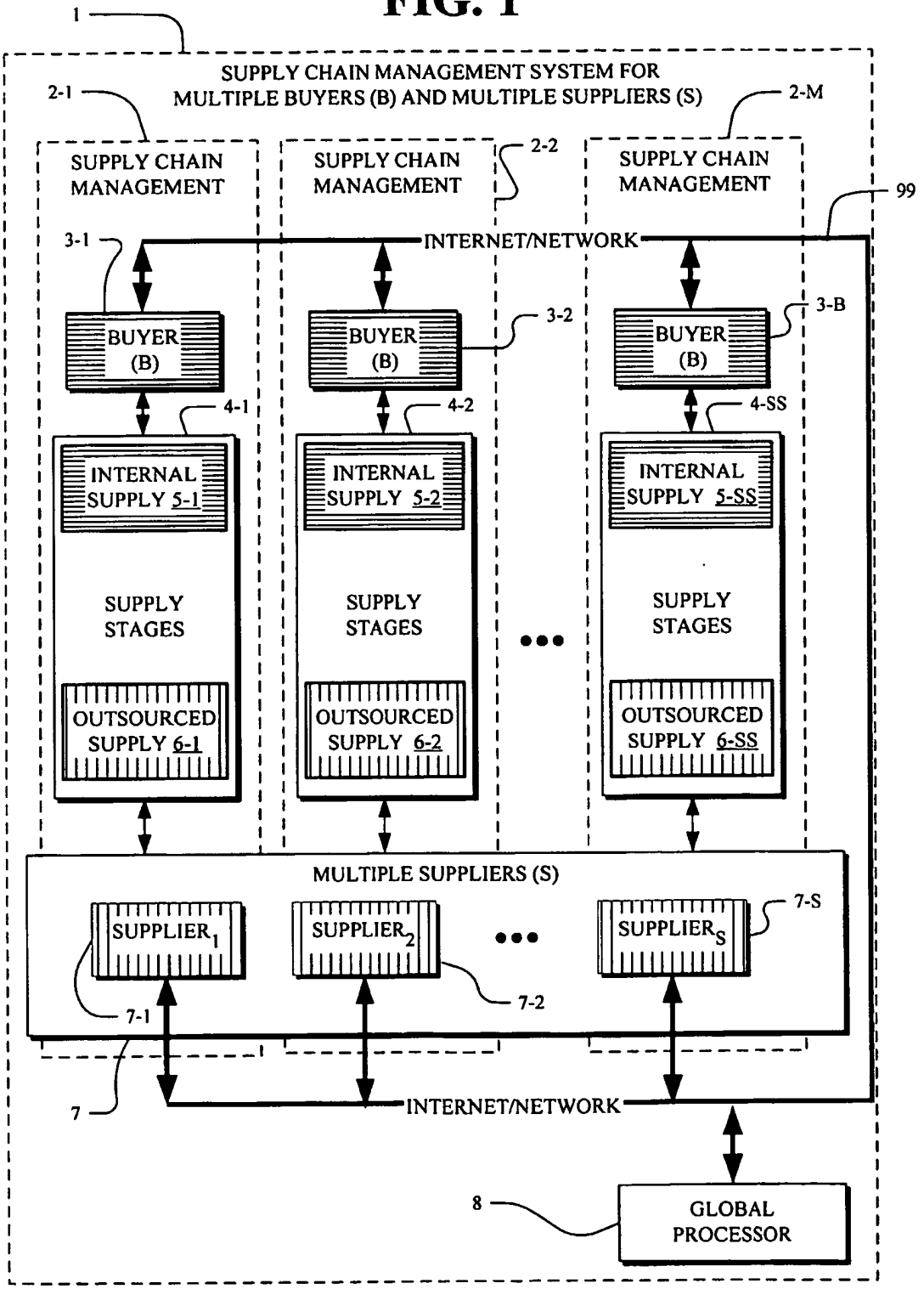

1
SUPPLY CHAIN MANAGEMENT SYSTEM FOR MULTIPLE BUYERS (B) AND MULTIPLE SUPPLIERS (S)
2-1
2-M
SUPPLY CHAIN MANAGEMENT
SUPPLY CHAIN MANAGEMENT
2-2
SUPPLY CHAIN MANAGEMENT
99
3-1
INTERNET/NETWORK
BUYER (B)
BUYER (B)
3-2
BUYER (B)
3-B
4-1
4-2
4-SS
INTERNAL SUPPLY 5-1
INTERNAL SUPPLY 5-2
INTERNAL SUPPLY 5-SS
SUPPLY STAGES
SUPPLY STAGES
SUPPLY STAGES
OUTSOURCED SUPPLY 6-1
OUTSOURCED SUPPLY 6-2
OUTSOURCED SUPPLY 6-SS
MULTIPLE SUPPLIERS (S)
SUPPLIER1
SUPPLIER2
SUPPLIERS
7-S
7-1
7-2
7
INTERNET/NETWORK
8
GLOBAL PROCESSOR

FIG. 2

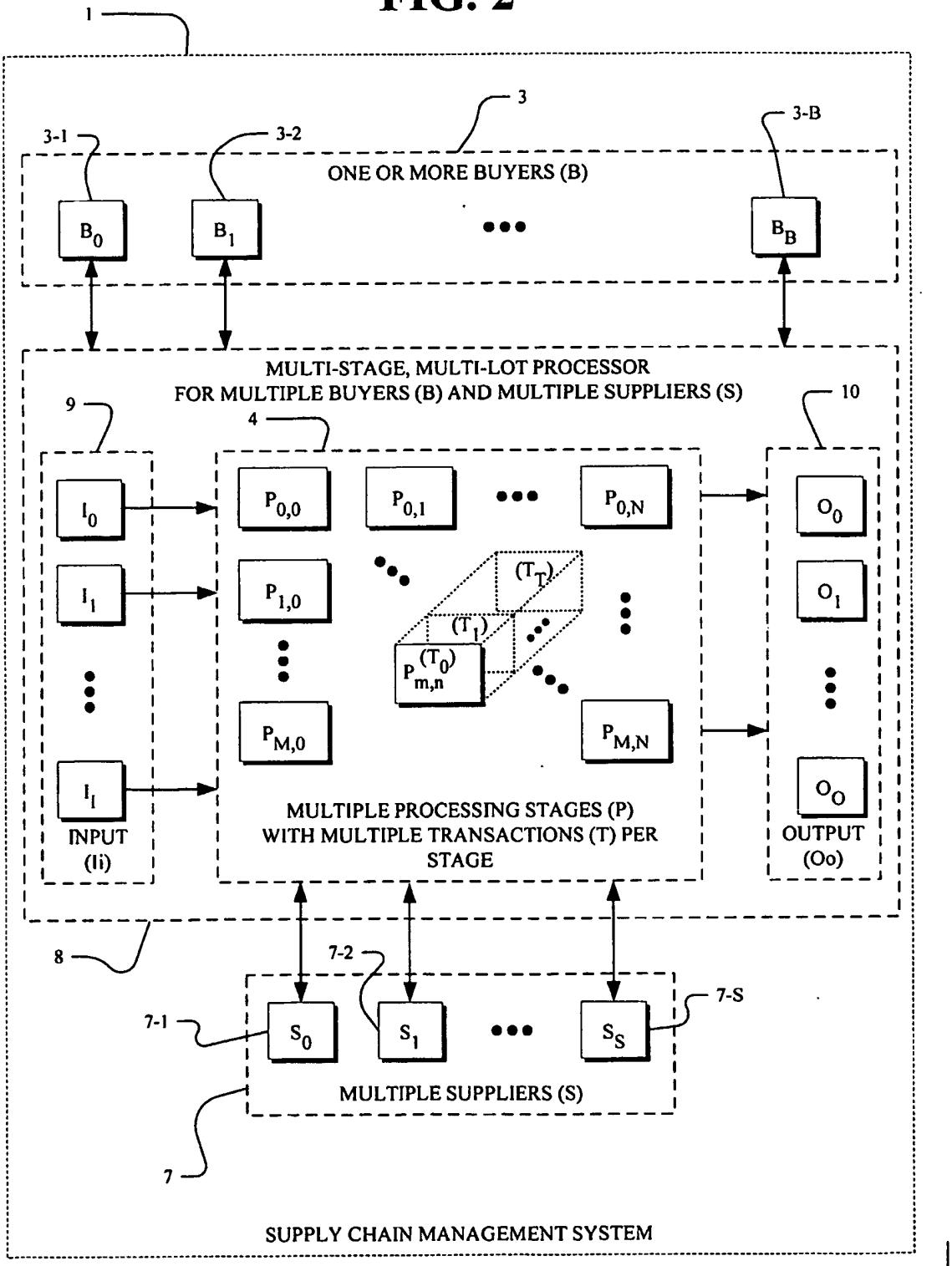

1
3
3-1
3-2
3-B
ONE OR MORE BUYERS (B)
B_0
B_1
B_B
MULTI-STAGE, MULTI-LOT PROCESSOR
FOR MULTIPLE BUYERS (B) AND MULTIPLE SUPPLIERS (S)
9
4
10
I_0
I_1
I_I
INPUT
(Ii)
$P_{0,0}$
$P_{0,1}$
$P_{0,N}$
$P_{1,0}$
$P_{M,0}$
$P_{M,N}$
$P_{m,n}$
(T_T)
(T_1)
(T_0)
MULTIPLE PROCESSING STAGES (P)
WITH MULTIPLE TRANSACTIONS (T) PER
STAGE
O_0
O_1
O_O
OUTPUT
(Oo)
8
7-2
7-1
7-S
S_0
S_1
S_S
MULTIPLE SUPPLIERS (S)
7
SUPPLY CHAIN MANAGEMENT SYSTEM

FIG. 3

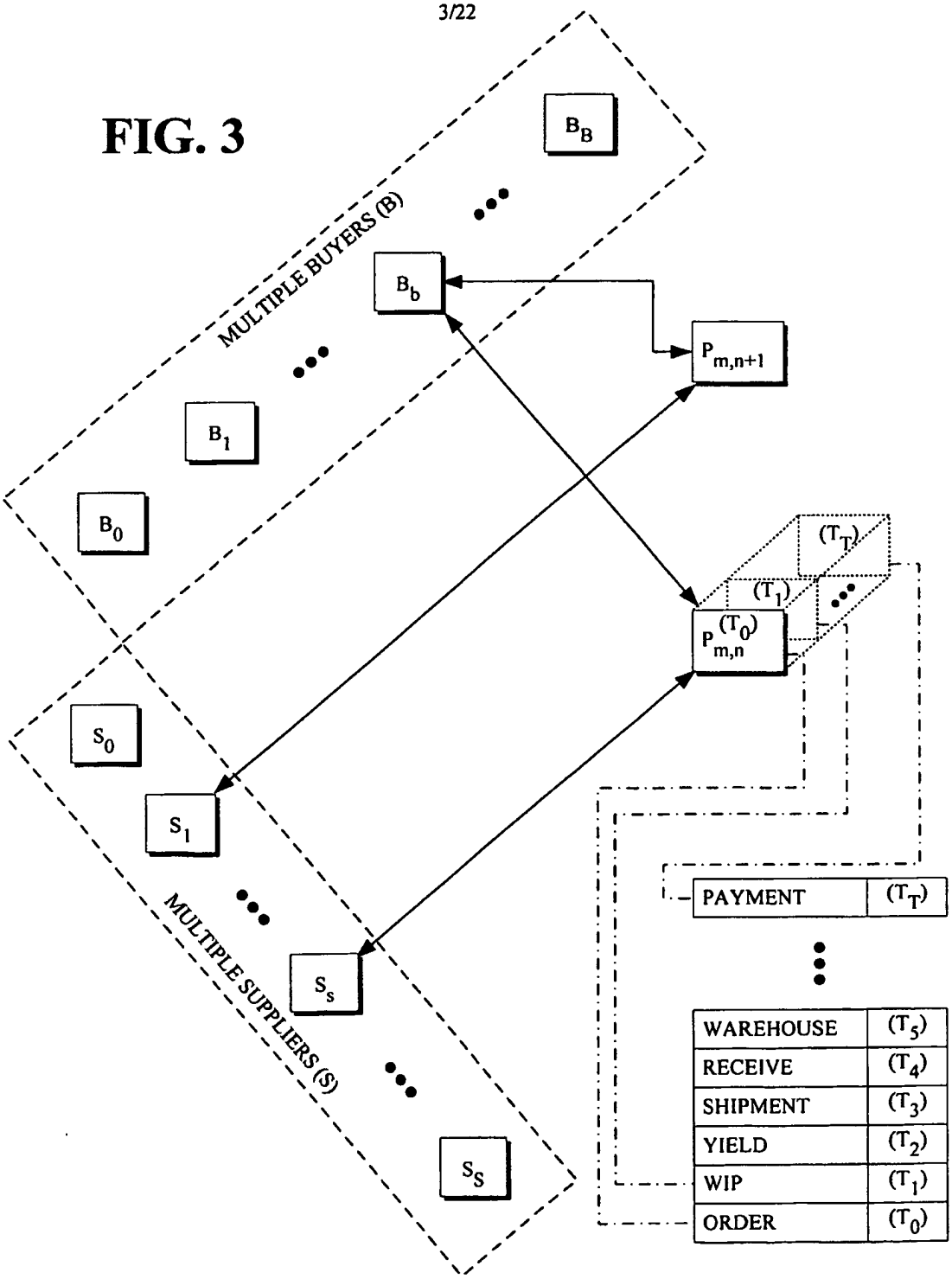

MULTIPLE BUYERS (B)
B_B
B_b
B_1
B_0
$P_{m,n+1}$
(T_T)
(T_1)
$P_{m,n}^{(T_0)}$
MULTIPLE SUPPLIERS (S)
S_0
S_1
S_s
S_S
PAYMENT (T_T)
WAREHOUSE (T_5)
RECEIVE (T_4)
SHIPMENT (T_3)
YIELD (T_2)
WIP (T_1)
ORDER (T_0)

FIG. 4

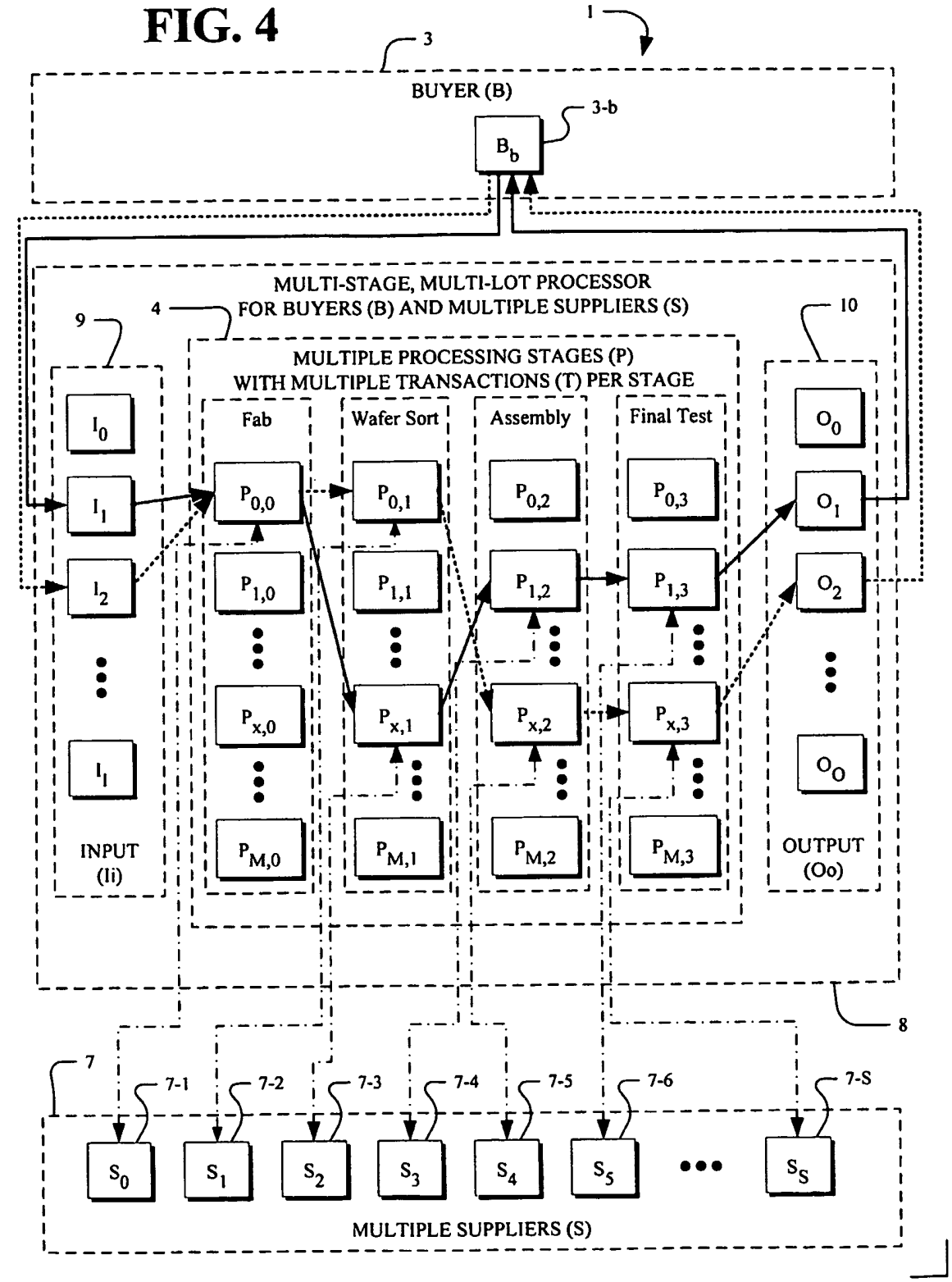

1
3
BUYER (B)
3-b
B_b
MULTI-STAGE, MULTI-LOT PROCESSOR
FOR BUYERS (B) AND MULTIPLE SUPPLIERS (S)
4
9
10
MULTIPLE PROCESSING STAGES (P)
WITH MULTIPLE TRANSACTIONS (T) PER STAGE
Fab
Wafer Sort
Assembly
Final Test
I_0
I_1
I_2
I_I
INPUT
(Ii)
$P_{0,0}$
$P_{0,1}$
$P_{0,2}$
$P_{0,3}$
$P_{1,0}$
$P_{1,1}$
$P_{1,2}$
$P_{1,3}$
$P_{x,0}$
$P_{x,1}$
$P_{x,2}$
$P_{x,3}$
$P_{M,0}$
$P_{M,1}$
$P_{M,2}$
$P_{M,3}$
O_0
O_1
O_2
O_O
OUTPUT
(Oo)
8
7
7-1
7-2
7-3
7-4
7-5
7-6
7-S
S_0
S_1
S_2
S_3
S_4
S_5
S_S
MULTIPLE SUPPLIERS (S)

FIG. 5

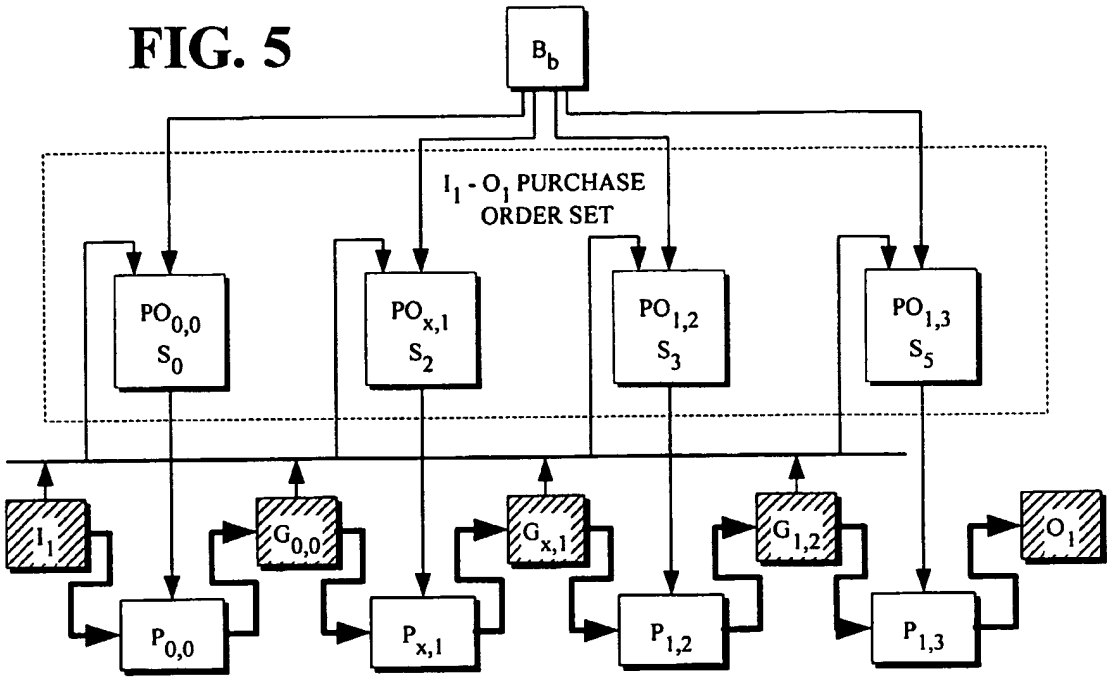

B_b
I_1 - O_1 PURCHASE ORDER SET
$PO_{0,0}$ S_0
$PO_{x,1}$ S_2
$PO_{1,2}$ S_3
$PO_{1,3}$ S_5
I_1
$G_{0,0}$
$G_{x,1}$
$G_{1,2}$
O_1
$P_{0,0}$
$P_{x,1}$
$P_{1,2}$
$P_{1,3}$

FIG. 6

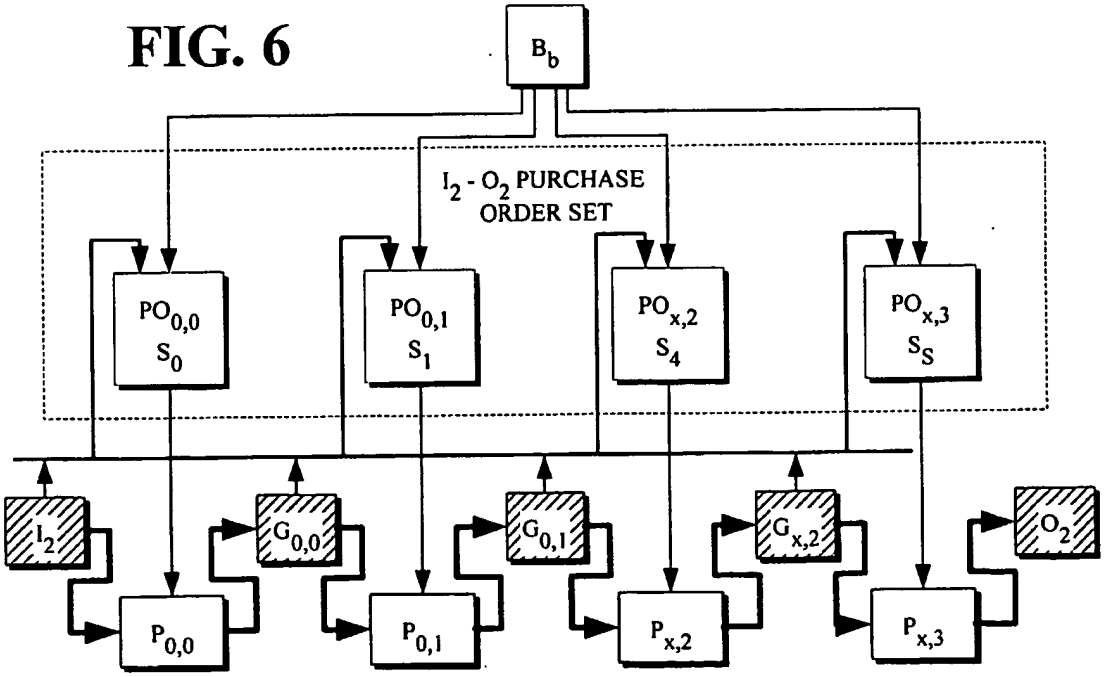

B_b
I_2 - O_2 PURCHASE ORDER SET
$PO_{0,0}$ S_0
$PO_{0,1}$ S_1
$PO_{x,2}$ S_4
$PO_{x,3}$ S_S
I_2
$G_{0,0}$
$G_{0,1}$
$G_{x,2}$
O_2
$P_{0,0}$
$P_{0,1}$
$P_{x,2}$
$P_{x,3}$

FIG. 7

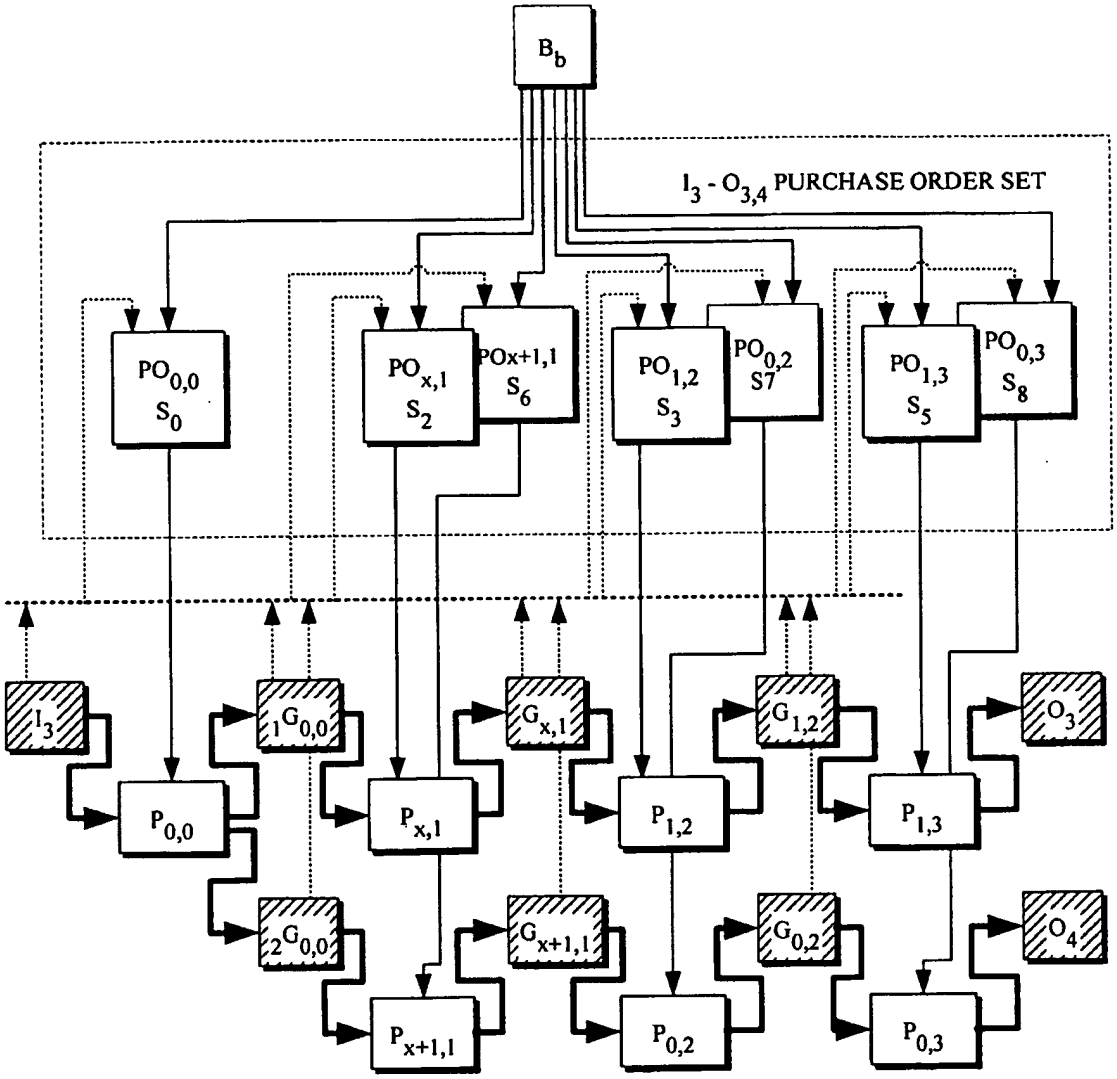

B_b
I_3 - $O_{3,4}$ PURCHASE ORDER SET
$PO_{0,0}$ S_0
$PO_{x,1}$ S_2
$POx+1,1$ S_6
$PO_{1,2}$ S_3
$PO_{0,2}$ S7
$PO_{1,3}$ S_5
$PO_{0,3}$ S_8
I_3
$_1G_{0,0}$
$G_{x,1}$
$G_{1,2}$
O_3
$P_{0,0}$
$P_{x,1}$
$P_{1,2}$
$P_{1,3}$
$_2G_{0,0}$
$G_{x+1,1}$
$G_{0,2}$
O_4
$P_{x+1,1}$
$P_{0,2}$
$P_{0,3}$

FIG. 8

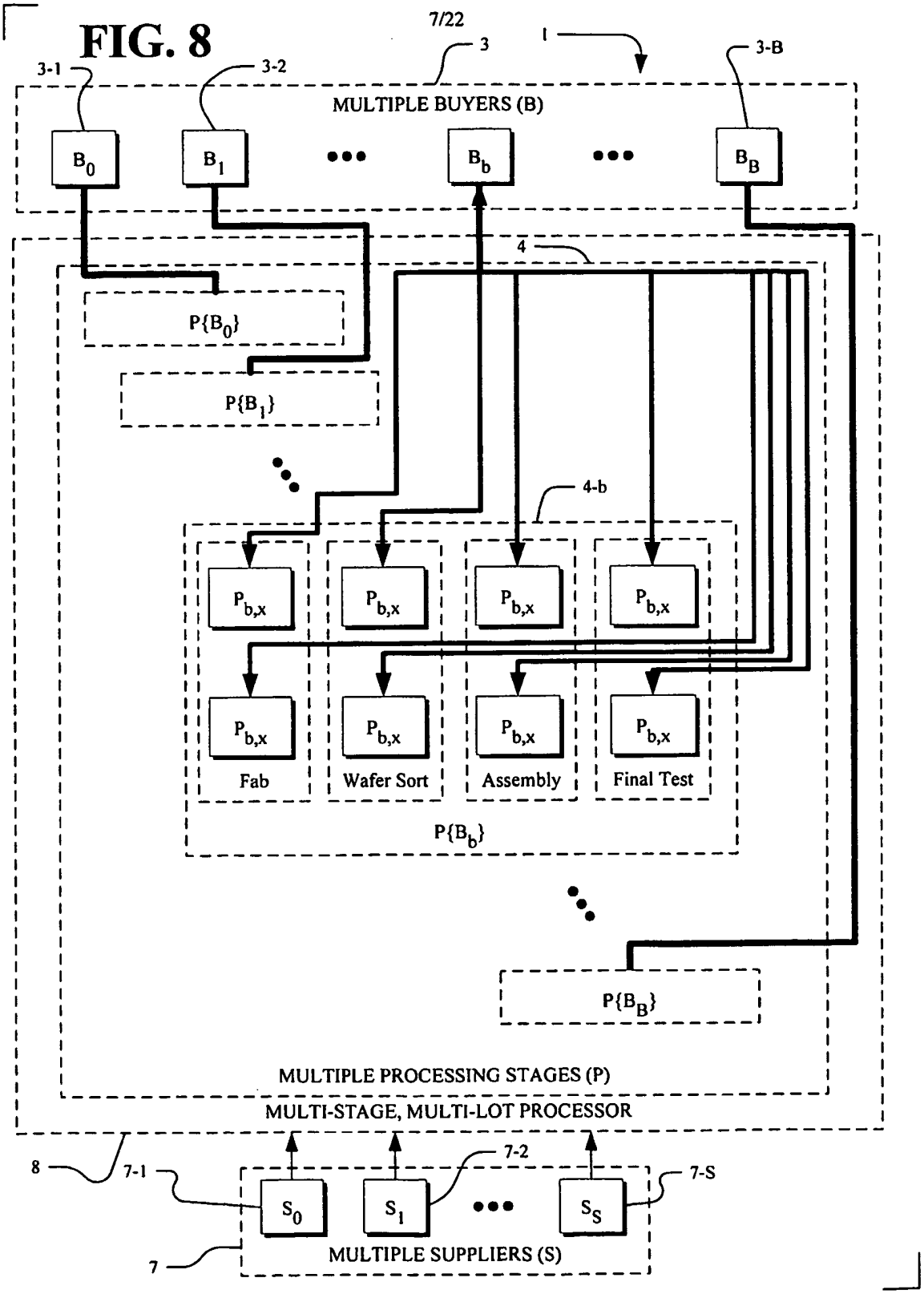

7/22
3
1
3-1
3-2
3-B
MULTIPLE BUYERS (B)
B_0
B_1
B_b
B_B
4
$P\{B_0\}$
$P\{B_1\}$
4-b
$P_{b,x}$
Fab
Wafer Sort
Assembly
Final Test
$P\{B_b\}$
$P\{B_B\}$
MULTIPLE PROCESSING STAGES (P)
MULTI-STAGE, MULTI-LOT PROCESSOR
8
7-1
7-2
7-S
S_0
S_1
S_S
MULTIPLE SUPPLIERS (S)
7

FIG. 9

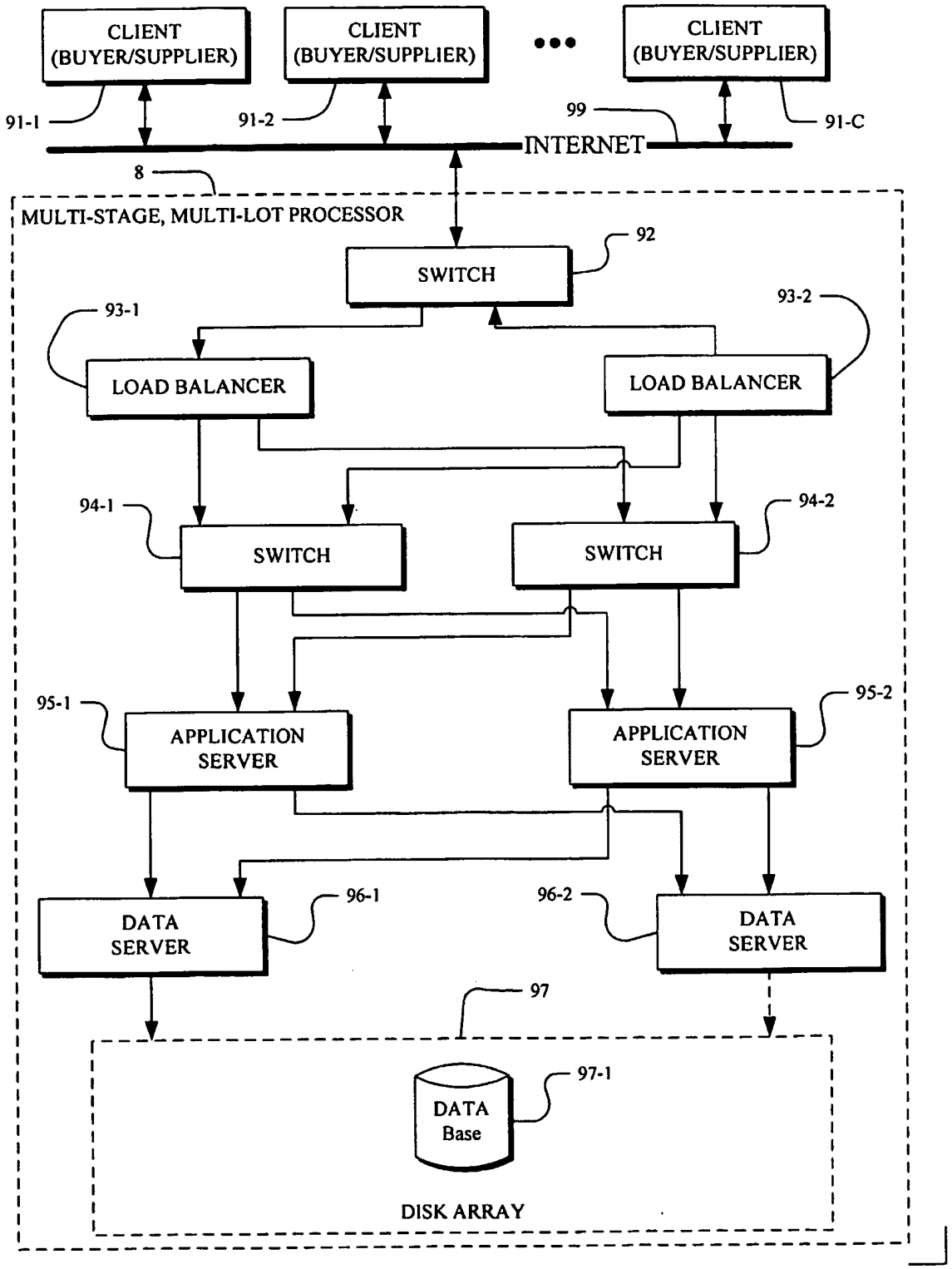

CLIENT (BUYER/SUPPLIER)
CLIENT (BUYER/SUPPLIER)
CLIENT (BUYER/SUPPLIER)
91-1
91-2
99
91-C
INTERNET
8
MULTI-STAGE, MULTI-LOT PROCESSOR
92
SWITCH
93-1
93-2
LOAD BALANCER
LOAD BALANCER
94-1
94-2
SWITCH
SWITCH
95-1
95-2
APPLICATION SERVER
APPLICATION SERVER
96-1
96-2
DATA SERVER
DATA SERVER
97
97-1
DATA Base
DISK ARRAY

FIG. 10

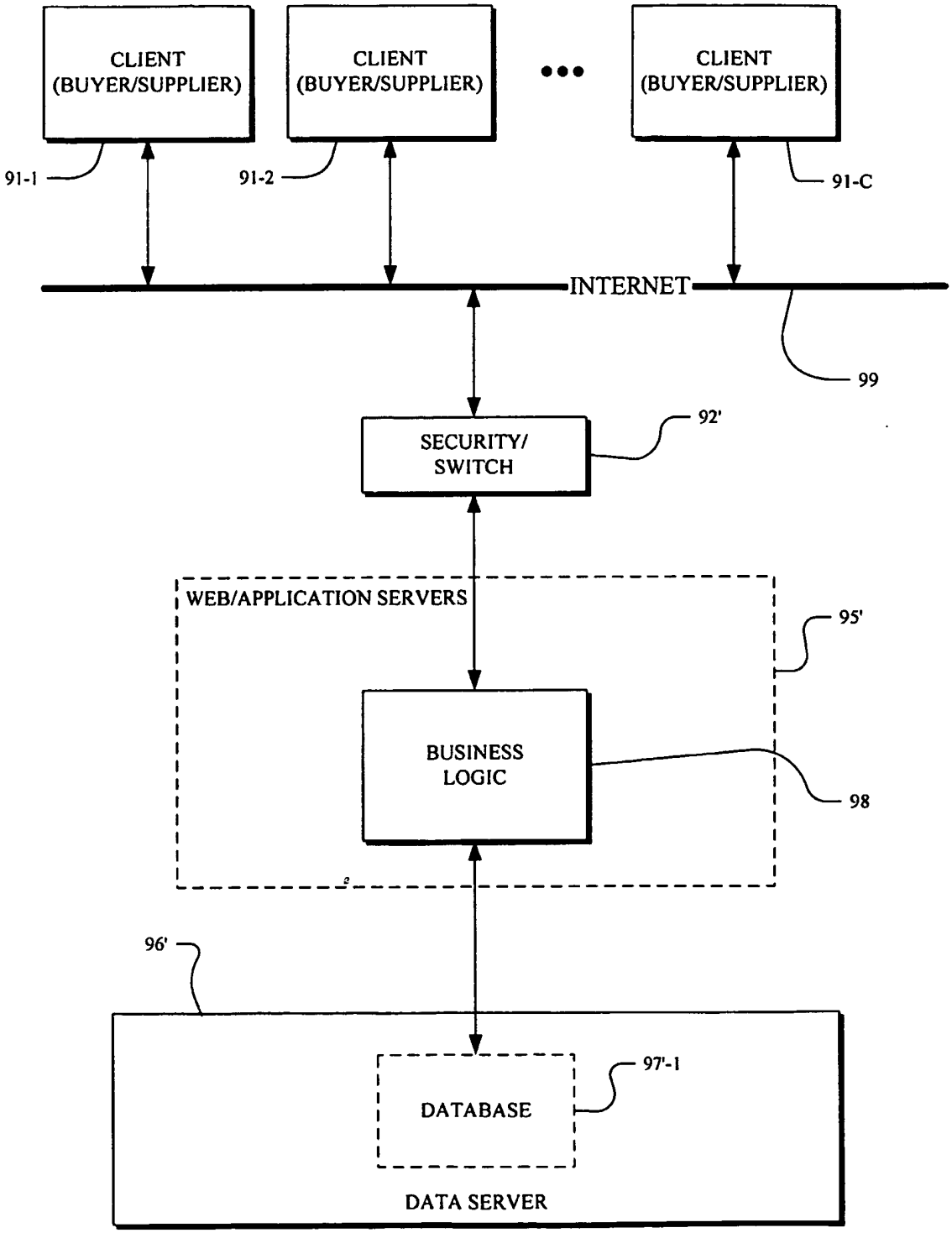
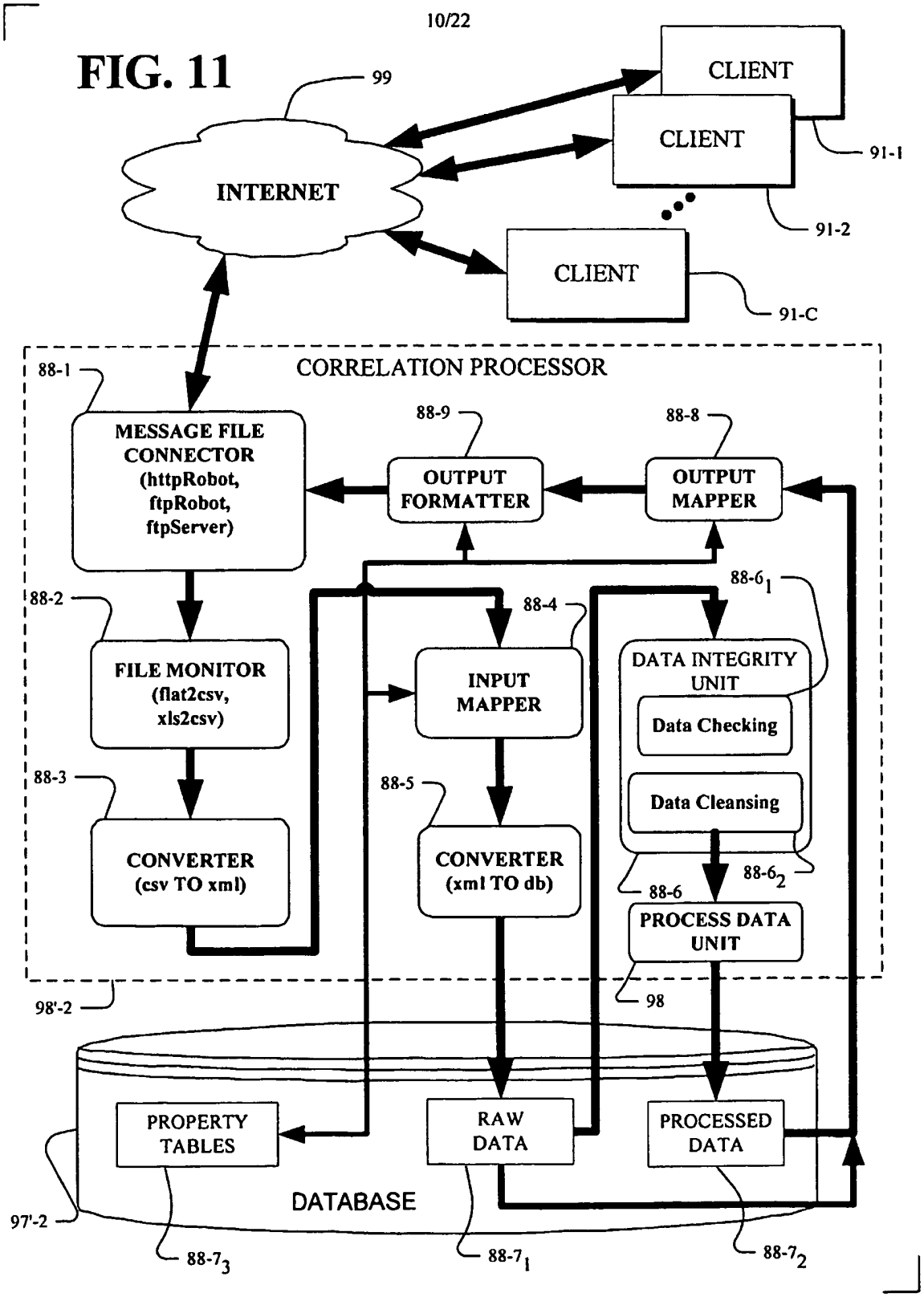

CLIENT (BUYER/SUPPLIER)
CLIENT (BUYER/SUPPLIER)
CLIENT (BUYER/SUPPLIER)
91-1
91-2
91-C
INTERNET
99
SECURITY/ SWITCH
92'
WEB/APPLICATION SERVERS
95'
BUSINESS LOGIC
98
96'
DATABASE
97'-1
DATA SERVER

FIG. 11


99
CLIENT
CLIENT
91-1
INTERNET
91-2
CLIENT
91-C
CORRELATION PROCESSOR
88-1
MESSAGE FILE CONNECTOR (httpRobot, ftpRobot, ftpServer)
88-9
OUTPUT FORMATTER
88-8
OUTPUT MAPPER
88-2
FILE MONITOR (flat2csv, xls2csv)
88-4
INPUT MAPPER
88-6$_1$
DATA INTEGRITY UNIT
Data Checking
Data Cleansing
88-3
CONVERTER (csv TO xml)
88-5
CONVERTER (xml TO db)
88-6$_2$
88-6
PROCESS DATA UNIT
98'-2
98
PROPERTY TABLES
RAW DATA
PROCESSED DATA
DATABASE
97'-2
88-7$_3$
88-7$_1$
88-7$_2$

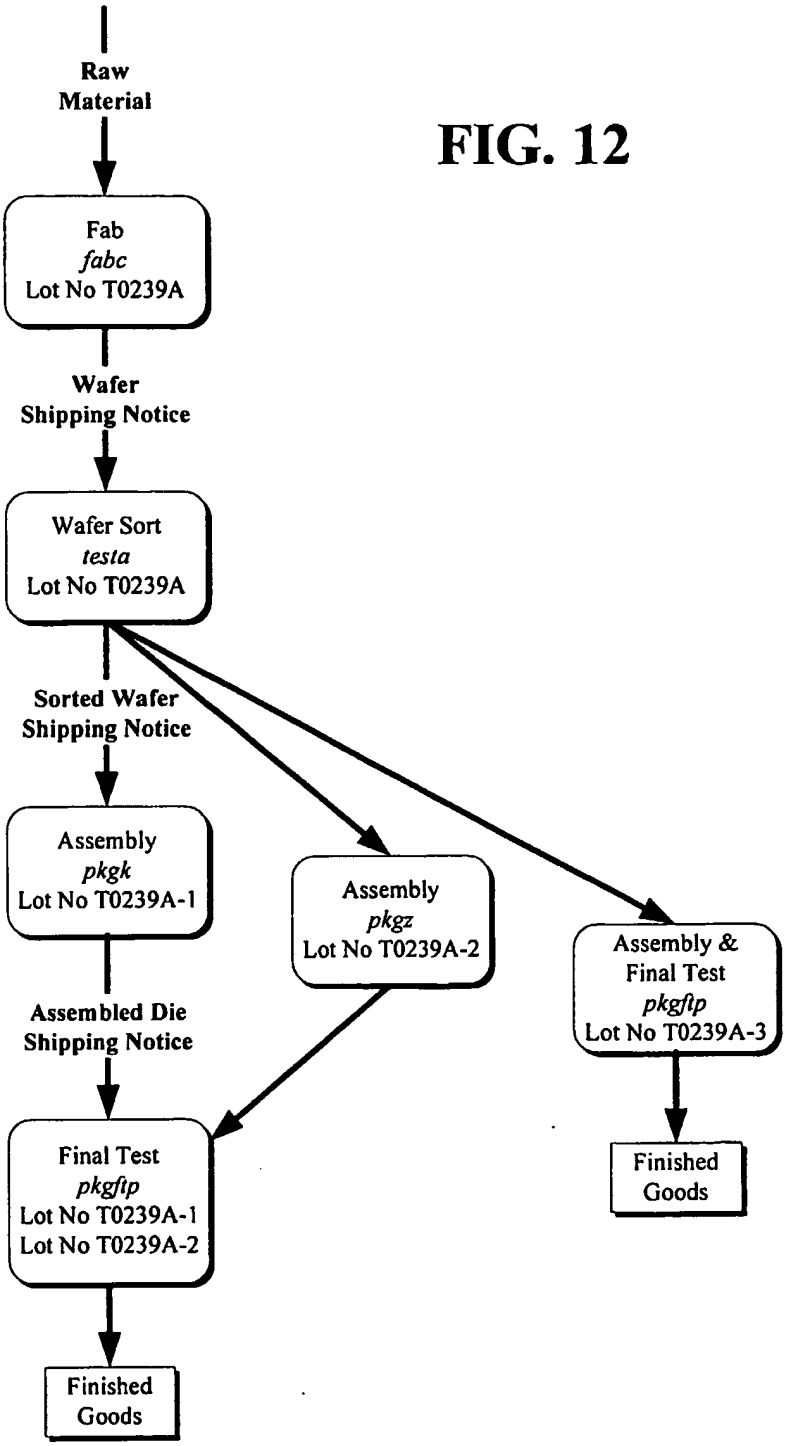

Raw Material
Fab
fabc
Lot No T0239A
Wafer Shipping Notice
Wafer Sort
testa
Lot No T0239A
Sorted Wafer Shipping Notice
Assembly
pkgk
Lot No T0239A-1
Assembly
pkgz
Lot No T0239A-2
Assembly & Final Test
pkgftp
Lot No T0239A-3
Assembled Die Shipping Notice
Final Test
pkgftp
Lot No T0239A-1
Lot No T0239A-2
Finished Goods
Finished Goods

FIG. 12

FIG. 13

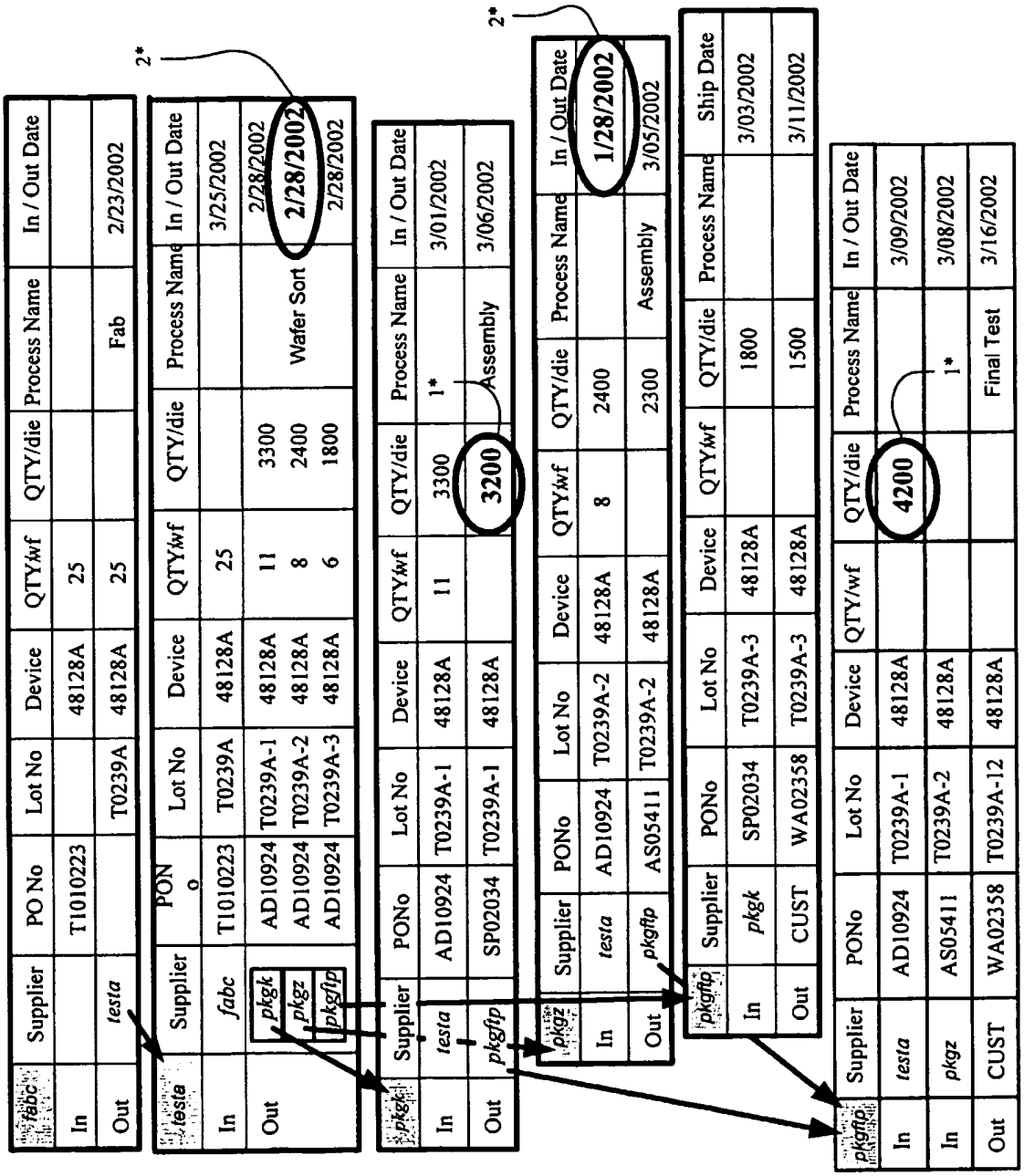

fabc
Supplier
PO No
Lot No
Device
QTY/wf
QTY/die
Process Name
In / Out Date
In
T1010223
48128A
25
Out
testa
T0239A
48128A
25
Fab
2/23/2002
testa
Supplier
PON o
Lot No
Device
QTY/wf
QTY/die
Process Name
In / Out Date
In
fabc
T1010223
T0239A
48128A
25
3/25/2002
Out
pkgk
pkgz
pkgftp
AD10924
AD10924
AD10924
T0239A-1
T0239A-2
T0239A-3
48128A
48128A
48128A
11
8
6
3300
2400
1800
Wafer Sort
2/28/2002
2/28/2002
2/28/2002
2*
pkgk
Supplier
PONo
Lot No
Device
QTY/wf
QTY/die
Process Name
In / Out Date
In
testa
AD10924
T0239A-1
48128A
11
3300
1*
3/01/2002
Out
pkgftp
SP02034
T0239A-1
48128A
3200
Assembly
3/06/2002
pkgz
Supplier
PONo
Lot No
Device
QTY/wf
QTY/die
Process Name
In / Out Date
In
testa
AD10924
T0239A-2
48128A
8
2400
1/28/2002
Out
pkgftp
AS05411
T0239A-2
48128A
2300
Assembly
3/05/2002
pkgftp
Supplier
PONo
Lot No
Device
QTY/wf
QTY/die
Process Name
Ship Date
In
pkgk
SP02034
T0239A-3
48128A
1800
3/03/2002
Out
CUST
WA02358
T0239A-3
48128A
1500
3/11/2002
pkgftp
Supplier
PONo
Lot No
Device
QTY/wf
QTY/die
Process Name
In / Out Date
In
testa
AD10924
T0239A-1
48128A
4200
3/09/2002
In
pkgz
AS05411
T0239A-2
48128A
1*
3/08/2002
Out
CUST
WA02358
T0239A-12
48128A
Final Test
3/16/2002

FIG. 14

Lot Tracking Report

Wednesday, Sept 05, 2001 6:18:49 PM (local time)

Please input a lot number (priority search criteria):

OR select by Device: 9051BWBA Base Lot Number: N1805 Get Report

Base Lot	Lot No	Part No	Routing	Unit	Sup	Received Date	Received Qty	Start Date	Comleted Date	Completed Qty	Ship Date	Ship Qty	Order No	Yield (%)	Cycle Time
N1805	N1805		Fab	wafer	*fabc*			1/08/ 2001	02/08/ 2001	25	2/28/ 2001	25	200363		51
N1805	N1805		Wafer Sort	Die	*testa*	3/01/ 2001	67,250	3/02/ 2001	03/09/ 2001	64,514	3/09/ 2001	64,514	600079	95.9	7
N1805	N18058	IS41G16256 35K	Assembly	Die	*pkgk*	3/04/ 2001	64,514	4/09/ 2001	4/19/ 2001	64,393	4/21/ 2001	64,393	361258	99.8	10
N1805	N18058.1	IS41G16256 35K	Final Test	Die	*pkgftp*	4/21/ 2001	23,162	4/21/ 2001	5/13/ 2001	21,760	8/13/ 2001	21,760	351657	93.3	22
N1805	N18058.2	IS41G16256 35K	Final Test	Die	*pkgftp*	8/14/ 2001	22,879	8/14/ 2001	8/22/ 2001	20,873	8/22/ 2001	20,873	351661	91.2	8
N1805	N18058.3	IS41C16256 35K	Final Test	Die	*pkgftp*	8/23/ 2001	21,760	8/23/ 2001					351665		

FIG. 15

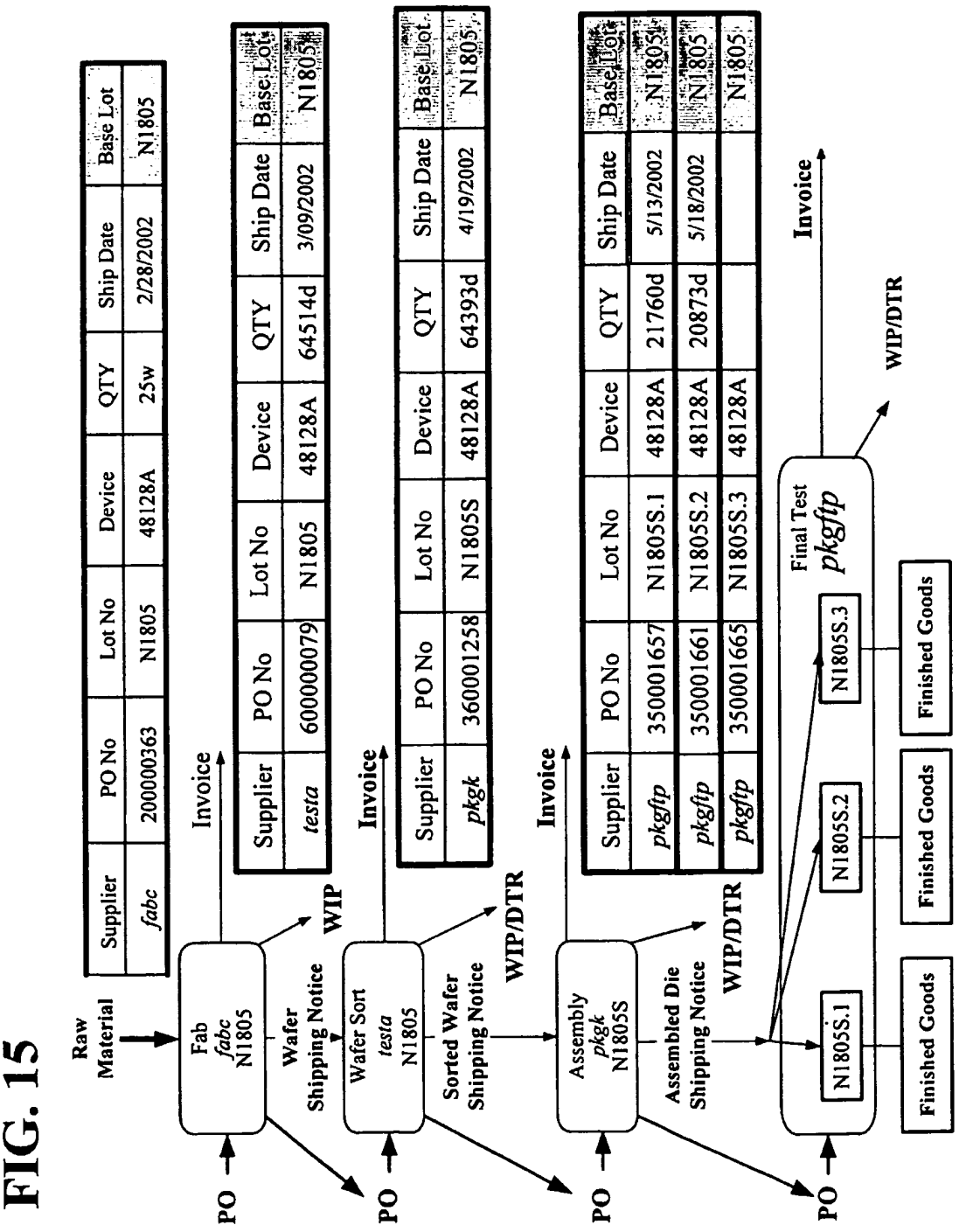
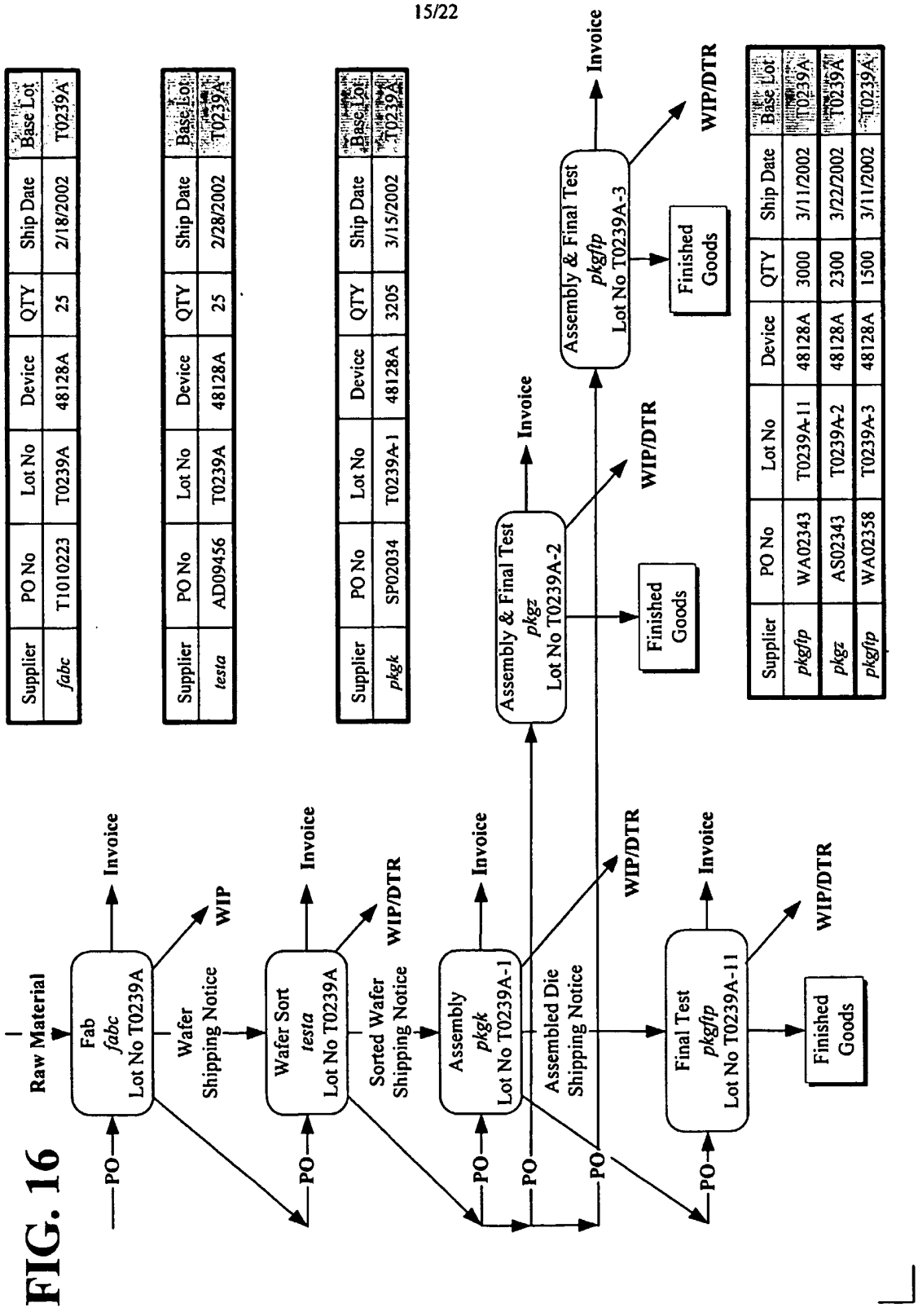

Raw Material
Supplier | PO No | Lot No | Device | QTY | Ship Date | Base Lot
fabc | 200000363 | N1805 | 48128A | 25w | 2/28/2002 | N1805
PO
Fab fabc N1805
Invoice
Wafer Shipping Notice
WIP
Supplier | PO No | Lot No | Device | QTY | Ship Date | Base Lot
testa | 600000079 | N1805 | 48128A | 64514d | 3/09/2002 | N1805
PO
Wafer Sort testa N1805
Invoice
Sorted Wafer Shipping Notice
WIP/DTR
Supplier | PO No | Lot No | Device | QTY | Ship Date | Base Lot
pkgk | 360001258 | N1805S | 48128A | 64393d | 4/19/2002 | N1805
PO
Assembly pkgk N1805S
Invoice
Assembled Die Shipping Notice
WIP/DTR
Supplier | PO No | Lot No | Device | QTY | Ship Date | Base Lot
pkgftp | 350001657 | N1805S.1 | 48128A | 21760d | 5/13/2002 | N1805
pkgftp | 350001661 | N1805S.2 | 48128A | 20873d | 5/18/2002 | N1805
pkgftp | 350001665 | N1805S.3 | 48128A | | | N1805
PO
N1805S.1
N1805S.2
N1805S.3
Final Test pkgftp
Invoice
WIP/DTR
Finished Goods
Finished Goods
Finished Goods

FIG. 16



Supplier	PO No	Lot No	Device	QTY	Ship Date	Base Lot
fabc	T1010223	T0239A	48128A	25	2/18/2002	T0239A

Supplier	PO No	Lot No	Device	QTY	Ship Date	Base Lot
testa	AD09456	T0239A	48128A	25	2/28/2002	T0239A

Supplier	PO No	Lot No	Device	QTY	Ship Date	Base Lot
pkgk	SP02034	T0239A-1	48128A	3205	3/15/2002	T0239A

Supplier	PO No	Lot No	Device	QTY	Ship Date	Base Lot
pkgflp	WA02343	T0239A-11	48128A	3000	3/11/2002	T0239A
pkgz	AS02343	T0239A-2	48128A	2300	3/22/2002	T0239A
pkgflp	WA02358	T0239A-3	48128A	1500	3/11/2002	T0239A

FIG. 17

Actual Cost-Lot Detail Report

Vendor: *pkgftp* **Process** FinalTest **Lot No** N1805S.1 Get Report

Part No IS41G16256-35K
Device 9051BWBA **BPO No** 700000691
Requestor Name Jennifer Lovejoy
Department Name & No Manufacture 44 **PO No** 350001657

Order Qty	Process	Description	Unit price (US$)	Est Amount	Complete Date	Actual Qty	Actual Charge	RE-Test	Approve	Approve Name
24,000	PRE75	100% Pre BI @75C	$0.061	$1464	5/09/2001	23,162	$1412.88	☐	☐	
24,000	BI6	100% BI @16hrs,125C	$0.050	$1200	5/11/2001	22,662	$1464.30			
24,000	POST75	100% Post BI Test@75C	$0.080	$1920	5/12/2001	22,162	$1772.96			
24,000	FT-5	100% F/T @-5C	$0.065	$1560	5/13/2001	21,862	$1421.03	☐	☐	
24,000	LS	100% Lead Scan	$0.015	$360	5/13/2001	21,760	$326.40	☐	☐	
24,000	Bake+DP	Bake & Dry Pack on Tray	$0.015	$120	5/13/2001	21,760	$108.80			
			Total Price	$6072			$6679.20			

FIG. 18

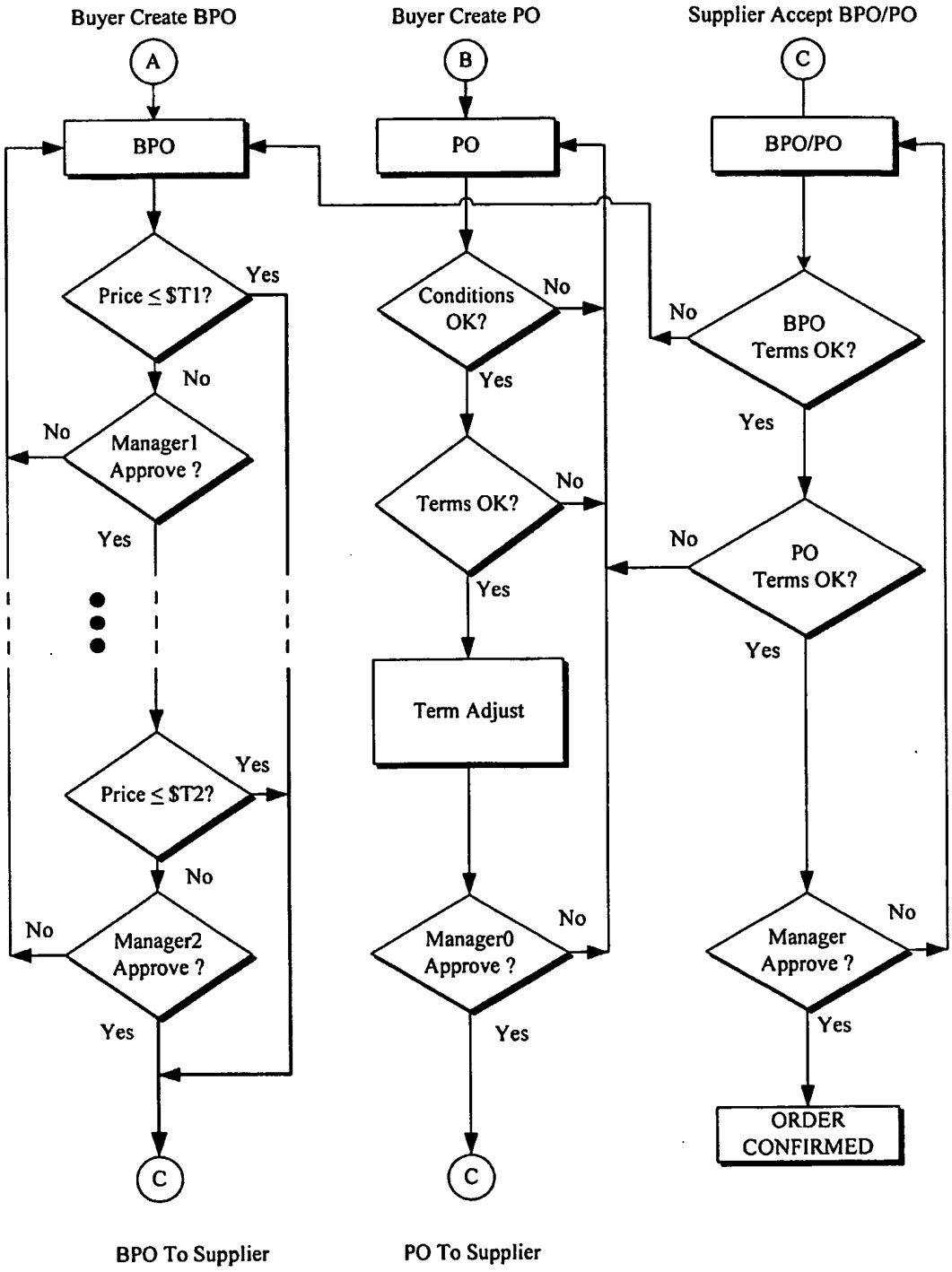

Buyer Create BPO
Buyer Create PO
Supplier Accept BPO/PO
A
B
C
BPO
PO
BPO/PO
Price ≤ $T1?
Yes
No
Conditions OK?
No
Yes
No
BPO Terms OK?
Yes
No
Manager1 Approve ?
No
Yes
Terms OK?
No
Yes
No
PO Terms OK?
Yes
Term Adjust
Price ≤ $T2?
Yes
No
No
Manager2 Approve ?
No
Yes
Manager0 Approve ?
No
Yes
Manager Approve ?
No
Yes
ORDER CONFIRMED
C
C
BPO To Supplier
PO To Supplier

FIG. 19
Final Test Purchase Order

		Date	2002/02/15
Part No	IS41G16256-35K	BPO No	700000691
Device	9051BWBA	PO No	350001657
Lot No	W3146900DM2	Revision No	01
Requester Name	Jennifer Lovejoy	Purchase Office	USA
Planner Code	1212		
Depart Name & No	44	Routing Code	301
		Routing Desc	Final test
Supplier	*pkgftp*	Payment Term	Net 30
Ship To	CUST	Prepaid	
FOB Point	San Francisco	Ship Via	BEST WAY

QTY	STEP	Description	Unit Price.	Extension.
24,000	PRE75	100% Pre B/I A@75C	0.061	1464.00
24,000	FT-5	100% F/T - 5C	0.065	1560.00
24,000	LS	100% Lead Scan	0.015	360.00

Total Price 3384

Remaining Balance 6616

ATTACHMENTS

File Name

APPROVEAL

DEPT	Name	Required
Manager	Jim Jones	
Assembly	James Smith	

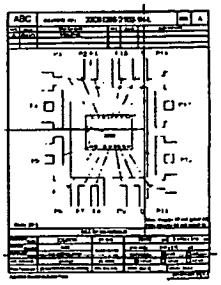
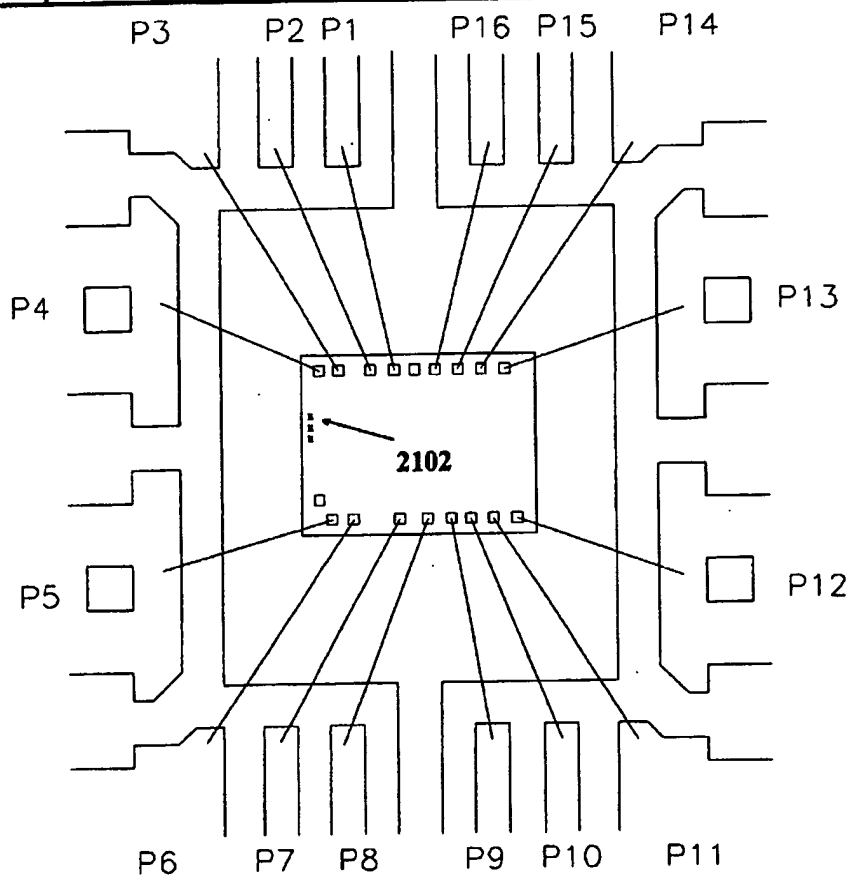


FIG. 20

ABC	DRAWING NO: 22C01286-2102-1N-L			REV.	A
REV.	DATE	DESCRIPTION	REV.	DATE	DESCRIPTION
A	02/11/99	ORIGINAL			



Max. length: 97 mil (pin# 14)
Min. length: 62 mil (pin# 4)

Scale 20:1

BILL OF MATERIALS

PRODUCT TYPE	22C01286	DIE SIZE	80X60 mil	2.032X1.524 mm
DEVICE /PART#	2102	LEAD FRAME	PAD SIZE: 140 x 170 mil	
PACKAGE TYPE	16L 300MIL PDIP		MATERIAL: ☒ C194 ☐ A42	
DIE ATTACH	AG03x7	AU WIRE	☒ 1.0 mil ☐ 1.2 mil ☐ 1.3 mil	
Mold Compound	SUMITOMO EME-6300H	NC= Pin# N/A	VCC= Pin# 12	GND= Pin# 4

Approval Record on Lotus Notes

280-600-004 REV. C
Q:\BONDING.DIA\BD\2\1\2102NL.DS4

FIG. 21

Wafer Rolling Output Report

Device: 500GACVE1 From Week: Week12 To Week: Week26 Get Report

PO No	PO DATE	PO DEVICE	W-12 2002-03-23	W-18 2002-05-04	W-19 2002-05-11	W-20 2002-05-18	W-21 2002-05-25	W-26 2002-06-29	FIN.	WIP	HOLD	TO START
						90			0	90	0	10
200000359	01/15/2001	5006ACVE1				100			100			
					97		23			120		
200000416	11/14/2001	5006ACVE1			120				120			
			47						47	0	0	53
200000428	12/11/2001	5006ACVE1	100						100			
								48		48	0	0
200000428	12/11/2001	5006ACVE1						48		48		
					48				0	48	0	0
200000469	03/13/2001	5006ACVE1		48					48			
			95	0	145	90	23	48	97	258	0	63
		TOTAL	148	48	120	100	0	48	416			

WO 03/107118 PCT/US03/17820

FIG. 22

Finished Goods Rolling Output Report

Planner	Device	Part No	Apr	May	Jun Plan	Jun Adj	Jun Out	Jun Var	July Plan	Jul Adj	Jul Out
Peter Sun	9051AWLA	61SF25616-1oT	0	0	0	1500	1500	-1500	0	1500	0
Peter Sun	**9051AWLA**	**Subtotal**	**0**	**0**	**0**	**1500**	**0**	**-1500**	**0**	**1500**	**0**
Peter Sun	9051BWBA	61SP32-133TQ	22826	11695	0	0	0	0	10000	10000	0
Peter Sun	9051BWBA	61SP32-5TQI	1600	22946	0	0	0	0	0	0	0
Peter Sun	9051BW	61SP36-166TQ	5349	0	0	0	0	0	0	0	0
Peter Sun	**9051BW**	**Subtotal**	**29775**	**34641**	**0**	**0**	**0**	**0**	**10000**	**10000**	**0**
Peter Sun	9054AX	61SF51218T-10TQ	0	0	0	5000	1979	-3021	0	3021	0
Peter Sun	**9054AX**	**Subtotal**	**0**	**0**	**0**	**5000**	**1979**	**-3021**	**0**	**3021**	**0**
Sam Lig	8085ST	62LV12816-55T	0	16270	30000	110000	2350	-107650	0	107650	0
Sam Lig	8085ST	62LV12816-55TI	288	0	0	0	0	0	0	0	0
Sam Lig	8085ST	62LV12816-55TIU	0	0	10000	10000	11100	10000	10000	8900	10000
Sam Lig	8085ST	62LV12816-70T	0	0	0	3000	3000	0	0	0	0
Sam Lig	8085ST	62LV12816-70TI	4257	0	0	0	0	0	0	0	0
Sam Lig	8085ST	62LV12816-55TI	1717	0	0	0	0	0	0	0	0
Sam Lig	8085ST	62LV12816-70BI	0	0	30000	70000	79330	9330	20000	10670	24176
Sam Lig	8085ST	Available.-Die	0	0	0	0	39136	39136	0	-39136	0
Sam Lig	**8085ST**	**Subtotal**	**6262**	**16270**	**70000**	**193000**	**134916**	**-58084**	**30000**	**88084**	**34176**

FIG. 23

Work In Progress Inventory Report

Routing ALL ▼ **Supplier** ALL ▼ **Planner** ALL ▼

Device ALL ▼ **Lot No** ALL ▼ **MCC** ALL ▼

Inventory Age [ ] days or more Search Reset **Part No** [ ]

Lot No	Device	Part No	Routing	Type	Wafer Qty	Die Qty	Supplier	MT Area
JW500941	8075ACVB2	8075ACVB2	Assembly	WH	0	553	*pkgx*	*D-pkgx*
JY030781	8075ACVB2	8075ACVB2	Assembly	WH	0	24086	*pkgy*	*D-pkgy*
JY030801	8075ACVB2	8075ACVB2	Assembly	WH	0	25554	*pkgz*	*D-pkgz*
JY030781	8075ACVB2	8075ACVB2	Wafer Sort	WIP	1	0	*testa*	*H-testa*
JW500941	8075ACVB2	8075ACVB2	Wafer Sort	WIP	2	0	*testa*	*H-testa*
JW500941	8075ACVB2	8075ACVB2	Wafer Sort	WIP	20	0	*testa*	*H-testa*
CF727300	8085STLA	8085STLA3	Wafer Sort	WIP	11	0	*testb*	*P-testb*
CF855800	8085STLA	8085STLA3	Wafer Sort	WIP	13	0	*testb*	*P-testb*
W1509700	8095AWLB	8095AWLB1	Final Test	WH	0	20080	*testc*	*D-testc*
W1510200	8095AWLB	8095AWLB1	Final Test	WH	0	21954	*testc*	*D-testc*
W1510100	8095AWLB	8095AWLB1	Final Test	WH	0	28672	*testc*	*D-testc*
W1509700	8095AWLB	8095AWLB1	Final Test	WH	0	32499	*testc*	*D-testc*